Computer Graphics and Public Policy

Bob Ellis

Barbara Simons

Myles Losch

Introduction to Public Policy

- Introduce Ellis and Simons
- Purpose of Course
- Why is this important?
- Organization of course

Bob Ellis

- Graphics S/W development
- Co-founded Sun's external research program
- Sun representative on CSPP Technology Committee
- Chair SIGGRAPH Public Policy Program

Barbara Simons

- Computing research (scheduling theory, compiler optimization, fault tolerant distributed computing)
- Chaired ACM Committee for Scientific Freedom and Human Rights
- Founding Chair USACM
- Past President ACM & Co-chair USACM

Purpose of Course

- Provide attendees with overview of digital technology policy issues
- Provide attendees with greater depth on issues particularly important to CG
- Provide reference material on public policy

Why is this important?

- Digital technology becoming ubiquitous in society
- Legislatures are passing new laws
- Courts are interpreting old and new laws in light of digital technology

Organization of Course

- Provide overview of policy issues in digital technology
- Explore in greater depth issues particularly important to CG
- How to affect and effect policy

Overview of Computing and Public Policy

- Cryptography (Simons)
- Broadband telecommunications (Ellis)*
- Electronic Commerce (Simons)
- Free Speech (Simons)
- Intellectual Property (Simons)*
- Digital Copy Protection (Ellis)*

Overview of Computing and Public Policy (cont'd.)

- Internet Futures (Simons)
- Privacy/Surveillance (Simons)
- Convergence of Computing and Television (Ellis)*
- User Access (Ellis)
- Research Support (Ellis)*

Policy Issues of Most Importance to Computer Graphics

- Deployment of Broadband Telecommunications
- Use and Protection of Intellectual Property (IP)
- Digital Copy Protection
- Convergence of Computing and Television
- Research Support

Conclusion

- Public Policy
- Summary and General Discussion

Deployment of Broadband Telecommunications

Bob Ellis

Broadband Telecom Topics

- Digital Subscriber Lines (DSL)
- Cable Data Services
- Satellite
- Terrestrial Wireless
- Security & Privacy
- Regulatory Policy

Digital Subscriber Lines – Technology

- Uses existing copper phone lines
- Signals co-exist with analog voice
- Continuously connected
- Can be switched in central office
- Many “flavors” (HDSL, SDSL, ADSL, …)
- Typical speeds up to 1.5 Mb/s)

Digital Subscriber Lines – Technology Issues

- Distance limited
- Crosstalk limited
- Likely to be asymmetric speeds
- Not generally user-installable
- May be multiplexed from central office

Digital Subscriber Lines – Policy Issues

- Cost
- Availability of service & support
- Tainted by ISDN debacle
- Regulatory confusion
- Lack of competitive service providers
- Provider mergers

Cable Data Services – Technology

- Ethernet connection to cable channel
- Shared service for subscribers
- Packets are encrypted
- 10Mb/s downstream
- Up to 2 Mb/s upstream
- Continuously connected
- Captive ISPs

Cable Data Services – Technology Issues

- Performance depends on active connections
- Performance depends on cable network topology
- Need Ethernet interface
- Asymmetric speeds
- Not generally user-installable

Cable Data Services – Policy Issues

- Somewhat regulated
- Not common carrier
- Open access problem
- Equipment not transferrable
- Hardware rental
- Provider mergers

Satellite – Technology

- Limited service
- Upstream services becoming available
- 400 Kb/s

Satellite –Technology Issues

- Upstream support new
- Shared resource
- Non-standard “modems” and receivers

Satellite – Policy Issues

- Cost
- Very new service
- Antenna placement
- Not common carriers

Terrestrial Wireless – Technology

- Not mobile service
- Line of sight
- Concentrated subscribers

Terrestrial Wireless – Technology Issues

- Bandwidth
- Cost (new infrastructure)
- Line of sight
- Signal may be affected by rain
- Receiver technology

Terrestrial Wireless – Policy Issues

- Spectrum allocation
- Antenna placement

Security & Privacy

- Continuously connected to Internet
- Static IP address
- Local networks
- Firewall security

Regulatory Policy

- Unfamiliar territory to consumers
- Unfamiliar territory to computing
- Unfamiliar territory to regulators
- Federal vs. local

Use and Protection of Intellectual Property (IP)

Barbara Simons

Copyright

Congress shall have the power ...

To promote the progress of science and the useful arts, by securing for limited times to authors and inventors the exclusive rights to their respective writings and discoveries.

User rights under Copyright

- First sale: I can give you my copy
  - Early 20th century publishers attempted to kill used book market by “licensing” a minimum price
- Fair use
  - for purposes such as criticism, comment, news reporting, teaching (including multiple copies for classroom use), scholarship, or research, is not an infringement of copyright.

Length of Copyright

- 1790: 28 years - originally 14 years ….
- Copyright Act of 1976: retroactively extended to up to 75 years after creation
- Sony Bono Copyright Term Extension Act 1998: extended yet another 20 years

The DVD Controversy

- DVD movies encrypted using Content Scrambling System (CSS)
  - Weak encryption
    - 40 bit key
    - proprietary algorithm
- Uses authentication to verify that player or operating system has been licensed
- Who can license open/free software systems?

CSS Broken - DeCSS

- Many people both inside and outside the U.S. involved anonymously with breaking CSS
  - DeCSS: one such program
- CLAIM: DeCSS needed to play legally purchased DVDs on Linux
  - Linux is widely used open source software
  - License for CSS includes non-disclosure
    - non-disclosure inconsistent with open source

Legal Case against Corley

- Lawsuit brought by Motion Picture Association of America (MPAA)
- Corley accused of posting DeCSS
  - Not accused of deriving DeCSS from CSS
  - Not accused of making illegal copies
- Corley subsequently deleted DeCSS from his web site, and instead posted links to other sites containing DeCSS

Arguments used by Defense

- Reverse engineering for compatibility allowed under DMCA
- Fair use guaranteed by copyright
  - Should not be able to eliminate indirectly via legislation
  - If DMCA holds, techies who can break encryption will have fair use right, but no one else will … including most judges

Trial results

- Judge ruled against Corley
  - Enjoined from posting DeCSS
  - Enjoined from **linking** to other sites with DeCSS
  - Case being appealed
- DeCSS can be legally published off-line, printed on tee shirts, sung
  - why should rights be lost on-line?

Technological Issues

- Will technology undermine fair use?
  - No fair use possible under CSS for DVDs
  - *What does it mean for fair use to be legal but the development of tools to enable fair use illegal?*
- Even if allowed to develop circumvention tools for fair use, posting them illegal under DCMA
- If software sold on DVDs, how can you make backup copies?

Impact on Books

- What is a library?
- Will books eventually be encrypted?
- Will copyright be replaced by contract law?
- Will we have pay-per-view?
- What are the implications for economically disadvantaged individuals and countries?

Issues

- Will technology undermine copyright?
  - No fair use possible under CSS for DVDs
  - What does it mean for fair use to be legal but the development of tools to enable fair use illegal?
  - Even if allowed to develop circumvention tools, it's illegal under DCMA to post them
  - If software sold on DVDs, how can you make backup copies?

Digital Millenium ...

- Outlaws reverse engineering except for compatibility, encryption & security research (with permission of copyright holder), privacy protection, and to protect minors against porn
- Since makes technologies or devices that are primarily designed for circumvention illegal, could criminalize some computer security R&D

Digital Millenium Criminal Penalties

- Circumvention of “copyright protection” or of “integrity of copyright management information” for commercial advantage or private financial gain:
  - first offense: <= $500K or <= 5 years prison, or both
  - subsequent offenses: <= $1M or <= 10 years prison, or both

Digital Era Copyright Enhancement (Boucher/Campbell)

- Prohibits altering or deleting copyright management information for purposes of infringement
- Prohibits enforcement of terms in "shrink-wrap" and "click-on" agreements when they reduce privileges recognized by copyright law
- Incorporates fair use and first sale rights

Digital Era Copyright Enhancement

- Ensures right of librarians & archivists to preserve copies of copyrighted works using latest technology
- Protects author's work under traditional legal understandings while allowing incidental copies for otherwise lawful use of a device.
- Civil rather than criminal penalties

Uniform Computer Transaction Act (UCITA)

Formerly Uniform Commercial Code (UCC) Article 2B

Will apply to shrink-wrap licenses

UCC 2B/UCITA

- Purpose of UCC is to create uniform regulations of commerce in different states
- Article 2B would have applied to shrink wrap licenses
- Lawyers group withdrew but state commissioners continued and passed UCITA

Shrink wrap licenses

- Not required to be made available prior to purchase
- Not required to state conditions clearly and legibly
- Allowed to prohibit publication of product reviews or results of benchmark tests without approval

Software publishers may

- Disclaim liability for known bugs in product
- Refuse compensation for help-desk charges for defective product
- Notify customer of change of terms via email
- Turn off software if customer violates terms of license after email notification (proof of receipt not required)

Small Businesses

- Cannot obtain a refund if cannot see license until after purchase - and you reject terms
- Cannot transfer shrink wrap software if sell business
- Cannot hold software publisher accountable for statements of fact in manual

UCITA Opposition

- 26 state attorneys-general
- Federal Trade Commission
- Software Engineering Institute
- IEEE-USA/USACM (educational)
- American Society for Quality
- New York City Bar
- Librarians
- Insurance industry
- Sun Microsystems

UCITA Supporters

- Primarily software manufacturers and related industry groups

Where are we going?

- What is a library? What will happen to public libraries?
- Is copyright being replaced by shrink-wrap licenses?
- Will copyright be replaced by contract law?
- Will we have pay-per-view?

What You Can Do

- If you are a researcher or editor, obtain policy of publisher with whom you work
  - Copyright?
  - Fair use?
  - Pricing for libraries?

What You Can Do

- Be informed as consumer and producer of information
- Work on educating policy makers and the judiciary about the implications of various proposals on technology
  - Unintended consequences, e.g. criminalizing technologies that can be used for circumvention and the impact on computer security R&D

Digital Copy Protection

Bob Ellis

Digital Copy Protection Topics

- Situation and Solution
- Technology
- DAT, DiVX and DVD
- CPRM, SDMI, etc.
- VHS copies
- Digital Television
- Issues

Situation

- Digital devices permit perfect copies
- Copyright holders fear infringement
- Copyright laws difficult to enforce

Solution

- Prohibit copying
- Authorize limited copying
- Leave audit trail
- Pay per view

Technology

- Encryption
- Digital watermarking
- No digital data stream

DAT, DiVX and DVD

- DAT failed in marketplace
- DiVX failed in marketplace
- DVD first successful product
- DVD Content Scrambling System (CSS)
- DeCSS
- License prohibits digital data stream
- Regional coding

CPRM, SDMI, etc.

- Content Protection for Recordable Media
- Secure Digital Music Initiative
- Globally Unique Identifier
- Includes computer, storage and peripheral manufacturers
- Would secure **all** recordable media

VHS

- Macrovision adds colorburst and other signals to vertical blanking
- Prevents VHS copies using composite and s-video outputs
- Product (VHS recorders) previously achieved success

Digital Television

- Content providers concerned
- “Free” broadcast television
- Betamax decision

Issues

- Impacts fair use
- Content providers don’t care
- DMCA prohibits production and distribution of circumvention technology
- Consumer acceptance
- May slow rate of DTV adoption

Convergence of Computing and Television

Bob Ellis

Myles Losch

Convergence of Computing and Television: Food for Thought

"... People will be canceling their Internet accounts because they can get most of what they want on interactive TV ...“

by Mark Snowden, Gartner Group senior research analyst for Internet and new-media businesses (quoted in "Daily Variety" for April 20, 2001 - page A2)

Convergence of Computing and Television: Topics

- Visions of convergence
- Motives for convergence
- Roots of convergence
- Forms of convergence
- Enablers of convergence
- Constraints on convergence
- Governmental roles in convergence

Visions of Convergence

- Entertainment and other video applications
- Diverse usage scenarios
- A Display is a Display

Motives for Convergence

- Cost
- Physical space
- Energy efficiency
- Visual realism
- User control

Roots of Convergence

- Japan's analog HDTV
- Digitization of electronics

Forms of Convergence

- Program origination: production and post-production
- Delivery: pre-recording; transmission
- Reception and viewing

Enablers of Convergence

- General purpose computers and software (open platforms)
- Integrated microcircuits and Moore's "Law“
- Open networks

Constraints on Convergence

- Global standardization
- Protectionism (industrial, cultural, political)
- Transmission infrastructure (wired and radio)
- Copyright issues

Governmental Roles in Convergence

- Radio spectrum allocation
- Technical standards adoption
- Transmission regulation
- Copyright policy setting
- International coordination

Research Support

Robert Ellis

Research Support Topics

- Role of government
- Role of the private sector
- SIGGRAPH activities

Role of Government

- Funding for research
- Research institutions
  - Peer-reviewed
  - Pre-competitive
- Commercial organizations
  - Contractor style
  - Should not pick winners and losers

Role of the Private Sector

- Take research and reduce to products
- Research is really product development
- Can’t do adequate peer review
- Support existing university research
  - Relevant work
  - Engineering support
  - Non-proprietary

SIGGRAPH Activities

- Computer graphics research misunderstood
  - Nothing left to do!
  - Frequently part of an application
- Working on NRC CSTB study
  - Definition complete
  - $50K for seed funding approved
  - Seeking additional sponsors

Public Policy

Bob Ellis
Barbara Simons

Public Policy Topics

- How policy is implemented
- How policy is influenced
- Role of technical societies
- Role of professionals
- Role of citizens
- Public policy organizations
- Web resources

How Implemented

- By legislative initiative
- By administration initiative
- By the courts

How Influenced

- By financial contributors
- By representatives of organized groups
- By constituents
- Meetings, calls, faxes and letters
- No email except for follow-up (no spam)
- Timing is everything!

Role of Technical Societies

- Inform members of issues
- Inform policy makers on technical aspects
- Possibly take positions

Role of Professionals

- Know the material and situation
- Contact with policy makers
- Testimony
- Outreach to general public
  - Speak at meetings
  - Talk with fellow citizens (and learn)
  - Make it relevant

Role of Citizens

- Contact with policy makers
- Comment on issues
  - Letters to policy makers
  - Letters to the editor (response is best)

Public Policy Organizations

- Provide focus on a set of issues
- Home for public policy professionals
- Contacts with policy makers
- Tracking and timing

Web Resources

- Almost everything worth knowing is on the web!
- Know who the site represents

Summary and Discussion

Bob Ellis

Barbara Simons

Overview Issues

- Cryptography
- Electronic Commerce
- Free Speech
- Internet Futures
- Privacy/Surveillance
- User Access

Computer Graphics Issues

- Deployment of Broadband Telecommunications
- Use and Protection of Intellectual Property
- Digital Copy Protection
- Convergence of Computing and Television
- Research Support

General Issues

- Public Policy Activities
- Issues not discussed

Discussion

Overview of Computing and Public Policy

Robert Ellis
August 2001

Introduction

As the general public's use of digital technology (computing, recording (CD, DVD, etc.) and data transmission (Internet, HDTV, etc.)) has dramatically increased, governments at all levels have been rapidly passing new laws and the courts have been busily interpreting these and existing laws. Many of these laws directly impact what you can and cannot do with this new technology for both your professional and personal use.

For example, in the pre-digital days you could access copyrighted printed material by simply buying a book or checking it out of a library. You might copy a few pages for your personal use but it was considerable work, expensive and the copies were generally not high quality. In the digital age, just to read material downloaded from the Internet or contained on a CD-ROM, a copy must be made inside your computer. Once there, perfect copies can be made with little or no trouble and expense. And perfect copies can be made from those copies. This simple change has had profound effects.

Cryptography

Cryptography is the use of mathematical techniques to transform data into a form that can't be interpreted by humans or machines until it is transformed back into a readable form by using a mathematical "key" or by extensive processing with a very powerful computer. It offers the only good technique to provide privacy of files and email messages. This is important because essentially anyone having access either physically or electronically to a computer is likely to have some capability to read data stored on that computer.

Unfortunately cryptography has not been widely used except by those who want to take strong measures to provide the security of their data. Cryptographic techniques have been awkward to use and not widely available, in part because some governments have restricted the use and export of software implementing "strong" (that which is unbreakable except by the most powerful computers) cryptography in order to keep it out of the hands of people who might abuse it. A number of proposals have been advanced which would require users of strong cryptography to register the transformation keys with trusted third parties which would then make them available to law enforcement agencies when appropriate approval has been obtained. Almost nobody has supported these proposals except law enforcement agencies.

Cryptography has lead to systems of digital copy protection (see below).

Digital Copy Protection

As holders of copyright protection on information have grown increasingly concerned about the ease of making perfect digital copies, they have begun to rely on techniques to restrict the ability of users of such information to make copies. Uses such as being quoted in criticism, scholarly research and copies made for personal, private and with no profit gained have been called "fair use". Many people are concerned that the widespread use of copy protection systems will give overly broad protection to copyright holders. Others see the need for such systems in order to further the "digital economy".

For example, DVD movies are protected by a system of weak encryption called CSS (Content Scrambling System) and licensees of CSS are prohibited from providing an unencrypted digital data stream. In fact the only way to view a DVD movie in digital form is on a laptop computer (or self-contained DVD player) with built in digital display screens or projectors. Of course CSS has been broken (DeCSS) and copyright holders of CSS-protected material have been quick to block its distribution and publication, actions that have run squarely into the objections of free speech advocates.

A number of consumer electronic devices such as DAT (Digital Audiotape) and DiVX (a special DVD player and discs) which have incorporated copy-defeating mechanisms have failed in the market place. Until the advent of inexpensive DVD players and widespread availability of movies in the format, consumers have generally not accepted such devices. CDs are not copy protected and until recently, it was easy to make copies of VHS videocassette tapes, but a product called Macrovision makes this impossible for some pre-recorded tapes.

New initiatives continue to be developed and promoted. The Secure Digital Music Initiative (SDMI) under development by contractors to the recording industry would provide copy protection to a wide range of consumer music devices. SDMI uses a watermarking technique which records a signal over the music content which is supposed to be imperceptible to human listeners but would be detectable by electronics and prevent copying of material so marked. A recent challenge to break SDMI has resulted in claims and counterclaims. Several research groups have claimed to break the technology, but SDMI supporters are not willing to agree that the copies have not been altered to human hearing. The departure of the effort's Executive Director in January 2001 has lead some observers to suggest that the initiative has failed, but not all agree.

The Content Protection for Recordable Media (CPRM) development includes computer, storage and peripheral manufacturers and would place copying from and to **any** recordable media under the control of copyright holders. This technology, currently in development by committee, would make it possible for software, music and video publishers to prevent any copying whatsoever internally or externally to the user's computer. It would require a Globally Unique Identifier (GUID) to be encoded on all protected devices and would not permit content to be copied to any device with a GUID different from the one registered by the customer.

Electronic Commerce

In spite of the much-described failure of many companies in this business, many people expect this to be the future of commerce. A number of obstacles exist. Many potential consumers are concerned over the safety of their personal information. Several highly

publicized events of unauthorized access to credit card numbers on these systems have reinforced these views.

Privacy is another stumbling block. In the U.S., there are almost no government restrictions on what a company can do with the personally identifying information they collect from their customers. Video rental records, information about children and student records are among the few exceptions. The only restrictions are that a company must abide by any voluntary statements (which may change with little or no notice) about what they will do with this information. In other countries there are laws which control the use of such information.

Sales and other taxes are another issue. In the U.S., sales taxes do not have to be collected unless the seller has a business presence in the state where the buyer resides. This is consistent with mail order sales. Most states do have "use" taxes that must be paid in lieu of sales taxes. Enforcement is lax but some states have begun to put questions regarding purchases falling under these provisions on their state income tax forms. The wide variation of sales tax rates imposed by states and local municipalities which do not even follow postal or telephone area codes boundaries are a valid impediment to collecting these taxes. Those who feel this situation puts local merchants at a disadvantage have proposed various schemes to make these tax rates uniform across the jurisdictions. The EC is also working on this issue by attempting to get sellers to collect the appropriate VAT.

Free Speech

The U.S. has strong constitutional protections against government restriction of the right to freely speak or publish. This has frustrated those who would impose such restrictions on unsolicited email or the availability of material deemed harmful to children. Several attempts to legislate such restrictions have been declared unconstitutional. These attempts include the 1996 Communications Decency Act (CDA) and the 1997 Child On-line Protection Act. Other measures include the 1998 Children's On-line Privacy Protection Act (COPPA) which restricts the type of information that can be collected from children under 13 and the 2000 Children's Internet Protection Act (CIPA) which will limit federal funding for Internet access in schools which don't have adequate technological protection measures (filters). COPPA and CIPA are still in the implementation stage. The fact that some speech is less protected than others is a recognized doctrine, but a U.S. Supreme Court justice has stated that the Internet deserves the highest form of protection because the cost of entry is so low.

Other countries have different traditions. For example several European countries have very strict laws controlling the availability of information and the sale of items related to events of World War II. This puts them at odds with many U.S. based Internet sites. While there are no U.S. laws against a private entity from restricting speech, different laws make it very difficult for Internet based companies because the Internet doesn't recognize national boundaries.

Considerable hope has been placed on filters which block access to certain "undesirable" Internet sites as a means for parents, librarians and schools to restrict access by children to those sites. As reported in USA Today, a Consumers Research project found major problems with all the filtering programs because they either blocked sites which should not have been blocked or failed to block obviously undesirable sites. Filters work by either

automatically searching sites for certain key words or phrases or by using humans to review Internet sites. Both methods have significant limitations in the world of the rapidly growing and changing Internet.

Intellectual Property

Intellectual property includes copyrights, patents, trademarks and trade secrets. In the United States, laws governing these derive from the U.S. Constitution. Article I, Section 8 (the powers of Congress) states, "To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries".

Besides being brief, this paragraph contains at least three important concepts. First there's the concept of rights for the authors and inventors. Second there's a concept of limited times. And last there's the concept of promoting the progress of science and the useful arts. Each of these concepts has given rise to aspects of the laws governing intellectual property. Also note that the term "intellectual property" is something of a spin because there is nothing in Article I, Section 8 that even suggests such ideas should be considered a form of property.

Rights for authors and inventors have directly lead to the laws governing copyrights and patents. These laws provide certain rights to the holders such as reserving the right to make copies or publicly perform a copyrighted work or to have exclusive use of patented inventions.

These rights are only available to the originators for a limited time. For example, patents are only valid for 17 years. Copyright protection for individual authors is the life of the author plus 90 years and for corporations it is the original publication plus 70 years. Some argue that these terms greatly exceed what the framers of the U.S. Constitution meant by a "limited time" because they are an appreciable fraction of the time of existence of the United States as a country.

Finally, the concept of promoting the useful arts has given rise to the requirement for disclosure of patent details and certain "fair use" in copyrights. For example, portions of a copyrighted work may be quoted in criticism or scholarly works and owners of copyrighted material may engage in certain acts of copying and use of the work as long as the actions are "personal, private and do not generate profit". For example the owner of a book or music CD may give away or even sell it. A person who receives copyrighted works on their television may make a copy for later viewing.

Copyright holders do not always agree to these definitions of fair use. It is generally regarded as permissible for the owner of a copyrighted CD to make a cassette tape copy to play in their automobile that may not have a CD player. The recording industry does not completely agree with this interpretation of fair use.

A recent international addition to the scene is the World Intellectual Property Organization (WIPO). WIPO is a United Nations' intergovernmental organization with some 175-member countries that was created to insure uniform treatment of copyright in all countries. WIPO has introduced a series of treaties which are being considered and generally accepted around the world.

In the United States one reaction to the WIPO treaties has been the passage of the Digital Millennium Copyright Act (DMCA). This law enforces certain aspects of the WIPO treaties. One highly controversial aspect of the DMCA is that it is now illegal in the U.S. to produce and distribute technology that would make available copyright works in digital form which are protected by technological means such as CSS which protects DVD contents. As noted in the earlier section on Digital Copy Protection, technology to "break" CSS has achieved much notoriety. In fact the current direction is to see who can develop the shortest program or script to do the job!

Internet Futures

Today's Internet had its start over 30 years ago as an U.S. Department of Defense research project. Access was initially restricted to organizations participating in the project. Over the years the access policy has gradually been relaxed, first giving access to other research institutions, then to commercial organizations (for non-commercial purposes) and finally to all forms of commerce.

But governance and control had always resided in the hands of research and commercial contractors to the U.S. government. A few years ago a non-profit corporation was formed called the Internet Corporation for Assigned Names and Numbers (ICANN) with an initially appointed board to oversee the administration of the Internet. From the start ICANN has been dogged with controversy ranging from the way board members were selected to fundamental concern over just what it's mission was.

Along the way, ICANN has performed some controversial actions. These range from developing a dispute resolution process, which some say favors large corporate interests, to soliciting and selecting a new set of top level domains (.biz, ..., etc.) a process that generated much controversy. Last year, ICANN held an election for board members elected by and representing the user constituency. This too has had its controversial aspects.

The future is anybody's guess. ICANN could work out the kinks and become an important force. Or the U.S. (and perhaps other governments) could take back control. Or perhaps even a coup might occur which would break all ties to governments and non-profit organizations and put control of the Internet into commercial hands.

This author has previously suggested a rather drastic solution to the problem of competition for certain domain names: do away with alphanumeric domain names and use the purely numeric IP addresses like the telephone system. Most see this as a step backward and a decidedly unfriendly move for users. It certainly would remove the issues of competition for particular domain names.

Recently a new style of Internet use called peer-to-peer (P2P) has been popularized by services such as Napster and Gnutella. In these services users share useful files by providing access to their computers via either a centralized or distributed directory of available files. Some observers have called this the future of the Internet.

I'd like to sound a cautionary note. Statistics show that only a small percentage (10%) of Napster users actually provide files while the vast majority only take copies of the files. Another concern is that users providing files are essentially operating Internet servers because the system only works well if the users providing the files have high bandwidth

connections and leave their computers connected to the Internet for long periods. There are two problems with operating a server. First many consumers' ISP agreements specifically prohibit operating a server. The reasons may be to reduce bandwidth problems for the ISP or even just a marketing strategy, but the restrictions exist and must be honored. Second, a long term, high bandwidth Internet connection exposes the user's computer to great security risks, something most consumers are ill equipped to handle.

We are all used to accessing the Internet without charge except for perhaps our basic connections. Recently Dan Gillmor, technology columnist for the San Jose Mercury News, has proposed that it may indeed be time for users to pay for the services they receive. The failure of many "free" Internet sites has shown that the current commercial models do not work over the long term and it's time for users to start paying their way.

Privacy/Surveillance

Privacy was discussed under cryptography and electronic commerce. Privacy legislation is currently very hot at all levels of government. Businesses generally feel that self-policing is the policy of choice, but recent problems involving business sites changing their privacy policies and deciding that collected personally identifying and aggregate data is a valuable business resource to be bought and sold. This is particularly a problem when a business is in financial difficulties and executives, stockholders and creditors are anxious to liquidate any resources of value.

Surveillance is also a current topic of much interest, particularly in the U.S. where freedom from massive government surveillance is guaranteed by the Constitution. Systems such as the FBI's Carnivore for legal "wire tapping" email messages and the biometric-based photo surveillance system employed at the recent Super Bowl has many people worried. Clearly there is a need to balance the rights of people and businesses and law enforcements need to protect.

Private surveillance is also an issue now that the Internet has made massive amounts of data available.

Telecommunications

Broadband access to the Internet is becoming widely available. Broadband Internet access is essential for anything but text and small audio and visual data streams. Unlike computing and the Internet itself, access is controlled by government-based telecommunications regulatory agencies.

The key to availability of broadband access is low cost, ease of installation and security for the users. All continue to be problems.

Many telecommunications regulatory agencies are concerned that customers of plain old telephone service (POTS) may be paying for a share of new services even if they don't use them so they control the price at which broadband access can be offered. Other agencies allow telecommunications companies to charge whatever they want for these services. Another problem is the fact that various forms of broadband access (DSL phone service, cable, satellite and wireless) are regulated differently or not at all.

Installation has been a problem and typically requires a service call. This raises the cost

and requires trained service personnel, although it's been getting better.

Security has remained a problem although not all users are as aware of the issue as they should be. Many of these services make the user's system very attractive to break-ins with their high speed access, fixed IP addresses, always on nature and services shared among many customers. Firewall systems and increased support from suppliers has partially addressed the problem, but much remains to be done.

Convergence of Computing and Television

Computer displays which are digital until the very end and television with its all-analog technology have always been separate. The advent of high definition digital television has the potential to change the situation. This could make possible the seamless connection of computer graphics and television.

Unfortunately there are many barriers. Television, unlike computing, is highly regulated. This means that the rate of adoption is not entirely in the hands of manufacturers, broadcaster or consumers. Spectrum allocation and availability of digital-ready TV sets are particular issues.

Protection of intellectual property is also an issue. Many digital television programming providers are worried that their copyrighted materials will be too easy to copy. This means we are probably headed for a situation where it may not be possible for consumers to record digital television programming. This is likely to slow down the adoption of this technology by consumers.

Research Support

Government support of research activities in computing is often criticized. The main theme of this criticism is that computer companies have lots of money so they should support research in this field like the pharmaceutical companies. Citing the pharmaceutical companies is somewhat misleading because a significant amount of their R&D expenditures are related to achieving government approval for new drugs, an expense which is not directly related to research.

Government support for science and technology research is sometimes misunderstood. Many people associate it with elected and appointed government officials picking winners and losers. While this is sometime true, usually a peer review process evaluates research support where knowledgeable scientists and technologists establish research priorities and review proposals for research.

Industry support on the other hand is directed towards work that generally affects the bottom line in the near term. Even industry support for research in universities is generally directed to projects that potentially impact the business in the near term. In addition, industry frequently supports research projects with the goal of proving the company's products to be superior to other products. Finally, industry does not typically have appropriate personnel to properly evaluate research projects.

Nevertheless, there is a role for industry support of internal and external research. In particular, the author has had several years' experience providing industry support for university research projects. This support typically was used to augment ongoing

research projects that were of interest to us. Our process also had the involvement of engineering sponsors. All of this support was for non-proprietary, pre-competitive research and the participants were encouraged to report any and all results in an unbiased manner. There is much to recommend this form of industry support university research.

User Access

There are two problems in user access. First, it has been noted that access to computing and the Internet are not equally distributed across all ethnic and economic groups. This disparity exists in many situations, but as computers and the Internet become key to access to government, social and economic systems concerns have been raised. There are many dimensions to the problem and there have been many studies with conflicting results; this limits the extent to which remedies can be developed.

The other access problem is that computing and the Internet are not as easy to use as they could be for people who are not technical experts or are challenged in some way. Some call this the usability problem. For example, many people with visual disabilities rely on "screen readers" that transform the printed material on a computer's display screen to verbal format. The Internet, with its graphically oriented interface sometimes defeats this technology unless a text-based form is also available.

Disclaimer

The author is not an attorney and the material in this work should not be considered legal advice. The material is the personal opinion of the author. The references to certain URLs contained in this work are provided as a service to the reader. Their presence should not be interpreted to mean that the author either supports or endorses the referenced material. Due to the dynamic nature of the Internet, the author cannot guarantee that these URLs are still valid at the time of this reading.

The author has made a best effort to determine the validity of the material at the time of writing, but makes no claims as to its continued validity.

About the Author

Robert Ellis retired in 1993 as Sun Microsystems' representative on the Technology Committee of the Computer Systems Policy Project (CSPP - an industry policy study organization) and co-manager of Sun's university research program. Previously, he held computer graphics software development and management positions with Sun, GE-Calma, Atari, Boeing and Washington University (St. Louis, MO). He received BS and MS degrees in Electrical Engineering and Computer Science from Washington University (St. Louis). Ellis currently does work as a volunteer for technical societies; he is a member of the Association for Computing Machinery's (ACM) US Technology Policy Committee (USACM) and serves as the Chair of the Public Policy Program of ACM's Special Interest Group on Computer Graphics and Interactive Techniques (SIGGRAPH).

References

General

The Association for Computing Machinery (ACM) U.S. Public Policy Committee (USACM) - http://www.acm.org/usacm/
ACM SIGGRAPH Public Policy Program - http://www.siggraph.org/pub-policy/
ACM SIGGRAPH Public Policy Program Announcement - http://www.siggraph.org/pub-policy/CGColumn-1197.html
ACM SIGGRAPH Public Policy Conference Reviews - http://www.siggraph.org/pub-policy/CGColumn-0598.html
ACM SIGGRAPH Public Policy Surveys - http://www.siggraph.org/pub-policy/CGColumn-02-2001.html
United States Constitution - http://www.nara.gov/exhall/charters/constitution/constitution.html

Cryptography

ACM - USACM on Encryption - http://www.acm.org/usacm/crypto/
Cryptography Research, Inc. - http://www.cryptography.com/
Litterio, Francis, Cryptography: The Study of Encryption - http://world.std.com/~franl/crypto.html
Rivest, Ronald L., Cryptography and Security - http://theory.lcs.mit.edu/~rivest/crypto-security.html
USENET Cryptography FAQs - http://www.landfield.com/faqs/cryptography-faq/

Digital Copy Protection (see also Intellectual Property)

ACM SIGGRAPH - Public Policy - http://www.siggraph.org/pub-policy/CGColumn-0898.html
ACM SIGGRAPH - DTV - http://www.siggraph.org/pub-policy/CGColumn-08-2000.html
ACM SIGGRAPH - Digital Watermarking - http://www.siggraph.org/pub-policy/CGColumn-0299.html
Digital Transmission Licensing Administrator - http://www.dtcp.com/
DVD FAQ - http://dvddemystified.com/dvdfaq.html
Macrovision - http://www.macrovision.com/dvd.html
Secure Digital Music Initiative - http://www.sdmi.org/
Secure Digital Music Initiative - http://www.cs.princeton.edu/sip/sdmi/
Content Protection for Recordable Media - http://www.dvdcca.org/4centity/tech/cprm/

Electronic Commerce

ACM - USACM on UCITA - http://www.acm.org/usacm/IP/#ucita
Americans for Fair Electronic Commerce Transactions - http://www.4cite.org/
Bad Software - http://www.badsoftware.com/
Computer Professionals for Social Responsibility on UCITA- http://www.cpsr.org/program/UCITA/ucita-fact.html
Digital Commerce Coalition - http://www.ucitayes.org/
Institute of Electrical and Electronics Engineers (IEEE) on UCITA - http://www.ieeeusa.org/forum/grassroots/ucita/index.html
Federal Trade Commission - http://www.ftc.gov/be/v990010.htm
National Conference of Commissioners on Uniform State Laws - http://www.nccusl.org/
UCITA News - http://www.ucitanews.com/

UCITA On-Line - http://www.ucitaonline.com/

Free Speech

ACM SIGGRAPH - Virtual Pornography - http://www.siggraph.org/pub-policy/CGColumn-05-2000.html
ACM - USACM on Free Speech - http://www.acm.org/usacm/speech/
American Civil Liberties Union - http://www.aclu.org/issues/cyber/burning.html
Center for Democracy and Technology - http://www.cdt.org/
Electronic Frontier Foundation (EFF) - http://www.eff.org/
Internet Free Expression Alliance - http://www.ifea.net/
Responsibility in Free Speech - http://www.zondervan.com/green.htm

Intellectual Property

ACM SIGGRAPH - Review of NRC Study on IP - http://www.siggraph.org/pub-policy/CGColumn-05-2000.html
ACM - USACM on Copyright - http://www.acm.org/usacm/IP/#copyright
ACM - USACM Intellectual Property Library - http://www.acm.org/usacm/IP/
American Library Association (ALA) Policy Activities - http://www.ala.org/work/
Association of Research Libraries - http://www.arl.org/info/frn/copy/ucitasum.html
Digital Millennium Copyright Act (DMCA) (Library of Congress) - http://www.loc.gov/copyright/legislation/dmca.pdf
Home Recording Rights Coalition (HRRC) - http://www.hrrc.org/
Motion Picture Association of America (MPAA)/Motion Picture Association (MPA) - http://www.mpaa.org/
Recording Industry Association of America (RIAA) - http://www.riaa.org/
Samuelson, Pamela (Guest Editor), Intellectual Property for an Information Age, *Communications of the ACM,* Vol. 44, No. 2, (February 2001), pp. 67-103.
World Intellectual Property Organization (WIPO) - http://www.wipo.org/

Internet Futures

ACM Internet Governance Project - http://www.acm.org/usacm/IG/
ACM SIGGRAPH - DNS Comments - http://www.siggraph.org/pub-policy/CGColumn-02-2000.html
ACM SIGGRAPH - White Paper - http://www.siggraph.org/pub-policy/whitepaperGII.html
Berkman Center ICANN-Related Content Archive - http://cyber.law.harvard.edu/icann/
Internet Corporation for Assigned Names and Numbers (ICANN) - http://www.icann.org/
ICANNWatch - http://www.icannwatch.org/
U.S. Dept. of Commerce ICANN Memorandum of Understanding - http://www.ntia.doc.gov/ntiahome/domainname/icann-memorandum.htm

Privacy/Surveillance

ACM SIGGRAPH - Broadband Security and Privacy - http://www.siggraph.org/pub-policy/CGColumn-1199.html
ACM - USACM on Privacy - http://www.acm.org/usacm/privacy/
Privacy International - http://www.privacyinternational.org/
Privacy.org - http://www.privacy.org/

Privacy Rights Clearinghouse - http://www.privacyrights.org/
Electronic Frontier Foundation (EFF) - http://www.eff.org/
Electronic Privacy Information Center (EPIC) - http://www.epic.org/
U.S. Federal Trade Commission - http://www.ftc.gov/privacy/

Telecommunications

ACM SIGGRAPH - Broadband Internet Access - http://www.siggraph.org/pub-policy/CGColumn-0599.html
ACM SIGGRAPH - Broadband Internet Access - http://www.siggraph.org/pub-policy/CGColumn-0899.html
ACM SIGGRAPH - Self-Installation of Broadband Internet Access - http://www.siggraph.org/pub-policy/CGColumn-11-2000.html
ACM SIGGRAPH - Letter to CACM - http://www.siggraph.org/pub-policy/letter1.html
Association of Local Television Stations - http://www.altv.com/
BroadBand Internet - http://www.broadband-internet.org/
Broadband Wireless Internet Forum - http://www.bwif.org/
CableLabs - http://www.cablelabs.com/
DSL Forum - http://www.adsl.com/
Federal Communications Commission - http://www.fcc.gov/broadband/
National Association of Broadcasters - http://www.nab.org/
NetAction - http://www.netaction.org/

Convergence of Computing and Television

ACM SIGGRAPH - Letter to FCC - http://www.siggraph.org/pub-policy/fcc.html
ACM SIGGRAPH - Digital TV - http://www.siggraph.org/pub-policy/CGColumn-1199.html
ACM SIGGRAPH - Digital TV - http://www.siggraph.org/pub-policy/CGColumn-02-2000.html
ACM SIGGRAPH - Digital TV - http://www.siggraph.org/pub-policy/CGColumn-05-2000.html
ACM SIGGRAPH - Digital TV - http://www.siggraph.org/pub-policy/CGColumn-02-2001.html
DigitalTelevision.com - http://www.digitaltelevision.com/
Federal Communications Commission - http://www.fcc.gov/dtv/
PBS - http://www.pbs.org/digitaltv/

Research Support

ACM SIGGRAPH - Prospective NRC Study on Computer Graphics Research - http://www.siggraph.org/pub-policy/CGColumn-02-2001.html
ACM - USACM on Science Research Support - http://www.acm.org/usacm/funding/
Computing Research Association (CRA) - http://www.cra.org/

User Access

ACM SIGCHI - Conference on Universal Usability - http://www1.acm.org/sigs/sigchi/cuu/

ACM SIGGRAPH - The Digital Divide - http://www.siggraph.org/pub-policy/CGColumn-08-2000.html
Closing the Digital Divide - http://www.digitaldivide.gov/
PBS - http://www.pbs.org/digitaldivide/

Deployment of Broadband Telecommunications

Robert Ellis
August 2001

This is a collection of articles that have appeared in the SIGGRAPH quarterly, Computer Graphics. The first article provides a survey of the technology and both technology and policy issues. The second article provides a much-needed update on security and privacy issues. The final article discusses the potential for user-installed DSL service.

"Last-Mile" Bandwidth Issues

Bob Ellis
Myles Losch

(Reprinted from Computer Graphics, May 1999)

Although bandwidth and computing capacity are issues throughout the Internet, it is perhaps most acute in the connections people have into their Internet Service Provider (ISP). It is the one parameter, other than content, which figures most heavily in their perception of the Internet. It is also about the only aspect, other than the capacity of their own computer that they can actually do something about. In the following sections we take a look at current technologies, survey technical issues and review policy issues associated with the new, high-bandwidth data communications services.

Computer professionals all know that response time is a critical aspect of user-computer access. Although it has been often reported, it has been most recently described by Jakob Nielsen (Nielsen, Jakob, "User Interface Directions for the Web", *Communications of the ACM*, January 1999/Vol. 42, No. 1, pp. 65-72 and http://www.useit.com/) in relation to the WWW. He describes necessary response times as: less than 0.1 second for the appearance of instantaneous feedback, less than 1.0 second for the user's flow of thought to stay uninterrupted and 10 seconds as the limit for keeping the user's attention focused on the dialogue.

Why is this so important? It is clear that high-speed communications provides a more positive graphics experience on the Internet. But just the ability to download graphics faster is not the primary benefit. One way to enable more people to use the Internet effectively is to present it as a graphical experience, both in terms of content and user interface, which requires response times as, described above.

Two examples come to mind. All of the new models for health care assume that individuals will take greater responsibility for their own interactions with health care professionals. The key to this is access to medical records. Imagine if these records were all on line (with suitable security and privacy protections) and patients could access data in their record by *graphically* exploring this data by looking at a chart showing the

timeline of significant events. See the LifeLines project of Ben Shneiderman and colleagues at the University of Maryland (http://www.cs.umd.edu/hcil/lifelines/).

The second example is help for the problem we have all faced of being “lost in cyberspace”. How many times have you worked your way through a web site (or series of web sites) only to discover that you had no idea of where you were in the structure or how to get back to a previous point? Although many sites try to provide some textual information on location, what’s missing is the computer equivalent of the familiar “You Are Here” maps found in many physical environments such as museums, zoos, etc.

Why don’t these capabilities exist? They do, but not on the Internet. And they don’t exist on the Internet because the bandwidth needed to provide the greatly increased amounts of data simply is not available to most users. In fact many who access the Internet over dial up lines do so with the graphics initially turned off!

For a summary of the potential, see the first SIGGRAPH public policy white paper (SIGGRAPH White Paper, “Computer Graphics, Visualization, Imaging and the GII: Technical Challenges and Public Policy Issues”, http://www.siggraph.org/pub-policy/whitepaperGII.html).

Because our knowledge is primarily of the situation in the United States, this description is of necessity oriented towards the U.S. However, some of the technologies described (e.g. the G.lite version of ADSL) are being globally standardized by the International Telecommunication Union (ITU) (www.itu.int), and others (e.g. for cable TV networks) will likely be adapted to conditions elsewhere.

Current and Near Term Future Technologies

Currently and in the near term future, few residences and small businesses will be directly served by optical fiber, because the construction and equipment costs of this technology can seldom be recovered within a reasonable time from such customers. Thus we don't discuss "fiber-to-the-home". Starting in the 1980s, a growing number of fiber-based competitive local telephone companies (Telco's) were launched to serve businesses in metropolitan areas. A few electric and/or natural gas utilities (including municipally owned ones) also began to use their rights of way for new fiber networks. The 1996 Telecom Act encouraged such trends, and this will gradually expand the number of available broadband data services, often in combination with other technologies that we examine more closely below.

It should be noted that broadband services for the residential market are usually priced at flat monthly rates between about US$40 and US$60, vs. typical current ISP charges for dialup access of around US$20/mo. We feel that these prices are generally attractive to consumers, given the improved performance.

Digital Subscriber Line

The Telco's plus some ISPs and new local carriers using Telco wires are starting to deploy and offer Digital Subscriber Line (DSL) service in a number of metropolitan areas. DSL employs a high frequency carrier signal on existing copper lines to provide high bandwidth digital communications. DSL can coexist with normal analog phone service. DSL is a continuously connected service. DSL connections will be supported by many of

the usual ISPs.

DSL comes in many variations, hence the acronym is frequently written as xDSL. The following paragraphs describe the key parameters. Note that some forms of DSL are asymmetric, meaning that the upstream bandwidth is lower than the downstream bandwidth. Depending on the application, this may or may not be a problem. Except as noted potential data rates decrease on longer loops (with the supported limit being about 18,000 feet from the Telco switching office). Line quality and configuration also affect performance, and some providers impose speed limits for marketing reasons, e.g. to enable tiered offerings priced for different customer groups.

1) HDSL: The earliest DSL service was developed by Bellcore in the 1980s. HDSL uses two wire-pairs (all other xDSLs use one) to provide T1 or fractional T1 service at lower cost than T1's original 1960s technology. Data rates are 1.5 Mbit/s in each direction. It is now being superseded by newer technologies.

2) SDSL: Advanced DSP chips enable T1 service (like HDSL) to be transported on only one wire-pair, so the limited capacity of Telco's' copper cables can be used more efficiently and costs lowered.

3) IDSL: IDSL provides "narrowband" ISDN's Basic Rate service (144 Kbit/s bi-directionally for the full 2B + D channel configuration), transported via DSL technology so as to lower the Telco's costs.

4) ADSL: ADSL is an asymmetric service designed for MPEG-2 compressed TV movies-on-demand, and is now used for Web surfing. It trades off upstream bandwidth (capped between 640 Kbit/s and 1 Mbit/s, depending on the implementation) so that up to 8 Mbit/s can be sent downstream. The asymmetry also deters businesses from replacing T1s with less-costly ADSL.

5) "G.lite" or "splitterless" ADSL: This is ITU-T's new standard for home Internet access. Unlike all other DSLs (for which an installer must visit the customer's site), consumers simply plug their "modem" into a home phone jack. To achieve this labor-cost and usability benefit, data
rates are capped at 1.5 Mbit/s downstream and 384 to 512 Kbit/s upstream.

6) VDSL: This still-evolving short-range service is ADSL's upward migration path. On a 1000-ft. loop (from a fiber terminal), up to the OC-1 rate of 52 Mbit/s can be sent downstream, vs. 1.5 to 6.4 Mbit/s upstream. A symmetrical business version is to carry the E3 rate of 34 Mbit/s bi-directionally. At VDSL's 4500-ft. loop length limit, speed roughly equals ADSL's. Telco's plan "fiber to the neighborhood" in support of VDSL wherever ADSL's use is heavy enough to justify the cost of running fiber. If multichannel HDTV movies-on-demand become popular, that would also justify early VDSL rollouts.

Good places to find out more about xDSL are www.adsl.com, www.ieee-occs.org/dsl_lite and www.uawg.org

Cable Data Services

Cable television companies are also rolling out their answer to the telephone companies'

xDSL services. A special interface (misleadingly called a cable “modem”) is used to interface a computer to the cable for data services. These interfaces are typically packaged as an external peripheral device that is housed in its own case like an external dial-up modem. The interface to the computer is then via a 10 Mbit/s Ethernet.

Bandwidths are typically up to 10 Mbit/s downstream and are capped between 200 Kbit/s and 2 Mbit/s upstream. Cable data service is a shared service for several subscribers using the same channel and traveling through all these subscribers’ interface cards. Packets are encrypted as a privacy measure. It is also a continuously connected service. Cable services, while regulated, are not common carrier services so Internet access is typically provided by captive service providers, such as @Home or RoadRunner.

Good places to find out more about cable data services are www.cablelabs.com and www.home.net or www.rr.com

Satellite

Satellite television providers have some limited data services. For example, DirecPC provides downstream data rates of 400Kbit/s. Because there is no practical way to provide uplink capability to subscribers, upstream data services must utilize another medium, such as telephone. Note that for some applications, such as Web surfing, the upstream data rate requirements are quite low and could be satisfied by analog modem connections.

Good places to find out more about satellite data services are www.direcpc.com and www.loral.com -- especially the latter site's details on CyberStar and Loral Orion.

Terrestrial Wireless

Cellular telephone service has had the ability to transmit data for a long time. But the bandwidths are low and the costs are high, so the service has primarily been used by a few individuals who wish to take advantage of Internet connections (mostly for email only) while traveling.

Companies like Ricochet are now providing medium speed data connections by blanketing an area with low power transmitters/receivers to provide an Ethernet-like connectivity without wires. It is only available in a very few metropolitan areas and is used mainly by traveling professionals who want Internet access.

High-speed broadband data services are starting to be provided by companies such as WinStar, Teligent and Advanced Radio Technology. The plan is to have fiber connected local hubs that feature line-of-sight to nearby buildings. These services are provided on frequency bands as high as 38GHz. Current economics result in targeting business customers located in buildings of 10,000 square feet or greater. Consumer service is not yet available, but multi-unit dwellings like apartment houses and condominium complexes have costs of service comparable to businesses of similar size. Thus, homes of this type are an attractive future market for service providers like those named above.

Other firms have been freed by the U.S.' 1996 telecom reform to offer broadband wireless

data services, and some have signaled interest in doing so. Among the potential players are:

1) Established wireline Telco's, which have for years used wireless local loop (WLL) radio equipment to serve very remote or inaccessible customers' premises. AT&T has been actively developing a new generation of such technology.

2) Digital cellular and PCS carriers, who are standardizing a new "third generation" (3G) family of services that carry data at up to the E1 rate of 2 Mbit/s. Note that fixed-site cellular data service dates from the 1980s, when it came into use for telemetry in scientific, industrial and security surveillance applications.

3) "Wireless cable" television service providers, and other owners of radio frequencies newly auctioned by the FCC.

4) Established terrestrial TV broadcasters, who may use parts of their newly granted digital TV channels for data transmission to paying customers.

Good places to find out more about terrestrial wireless data services are www.art-net.net, www.netro-corp.com, www.winstar.com and www.teligent.com.

Technical Issues

Digital Subscriber Line

Digital subscriber line services have two major technical limitations: they are distance and crosstalk limited. The Telcos" plans for incremental extension of fiber into residential areas (noted above under VDSL) will slowly address these constraints by shortening the copper loops used for older forms of DSL. Just how big a problem these shortcomings will be really waits to be assessed until the service is more widely deployed. DSL services may be asymmetric, with upload speeds significantly lower than download speeds. Whether or not this is a problem is largely application dependent. For example, surfing the Internet is largely thought to have large downloads in response to a few characters of user interaction data which is uploaded. One of us (Ellis) has noted in his own personal web surfing that the ratio of uploaded data to downloaded data may be as high as 1:4, a somewhat unexpected result.

Speeds are expected to be 52 Mb/sec for VDSL or (for ADSL) far less, varying with loop length and quality. New “modems” are also required which cost $200 or so. There’s also the question of installation, although some services (G. Lite ADSL) are user-installable.

Of course the high-speed “last-mile” service of xDSL (or any other broadband data service) is only as good as the complete path from subscriber to ISP. Subscribers should be aware that their path after reaching the Telco switching office may include being aggregated or multiplexed onto a circuit with many other subscribers. This might lower their throughput and response time if not properly engineered to handle large loads.

Cable Data Services

Although many people probably do not realize it, the tree-and-branch topology of existing

cable TV networks means that these services are a shared resource so there are concerns of lowered performance as more subscribers join. Cable operators plan to address this, like the Telcos cited above, through incremental fiberization guided by continuous performance monitoring. Thus, the cable network's topology will slowly evolve so that ever-fewer customers (ultimately, just one -- if traffic rises by enough) use each cable segment. In addition, there are security and privacy concerns, which cable industry standards will address through per-user encryption.

Speeds are also asymmetric, with faster download than upload speeds as previously noted. Non-standard modems are required although standards are being developed. Some early ones are 1-way, thus needing phone lines for uploading data. Also, lack of "plug and play" user installation has been a constraint. And since cable and PC technicians have limited cross training in each other's fields, they've had to be sent out in pairs, doubling labor costs.

The typical requirement of connecting the cable data interface to the computer via Ethernet requires an Ethernet interface on the computer. Typically, home computers do not have an Ethernet interface as standard equipment, and business computer users may not want to tie up an Ethernet port this way.

Satellite

Currently, services are provided on geosynchronous Direct Broadcast Satellites (DBS) which are definitely one way because the equipment used on customer premises is receive only. A second data service is needed for uploading. New Low and Medium Altitude Earth Orbits (LEO/MEO) communication satellites that Iridium and other new mobile service communications operators use, may enable two-way service, including mobile.

Non-standard "modems" and radios are required. And the shared resource nature of the service limits capacity in the short term.

Terrestrial Wireless

Bandwidth and cost are the primary concerns, plus the need for new (and non-standard) "modems". Other technical issues include the need for somewhat new technology for computing such as radios. Novel concerns include "line-of-sight" requirements and possible signal blockage by rain or other environmental factors! For "wireless cable" operators and terrestrial TV broadcasters, a further issue is their one-way radio infrastructures, which (like cable TV) were optimized to deliver non-interactive entertainment.

Policy Issues

Digital Subscriber Line

Although Telcos, ISPs and others are beginning to widely advertise DSL services, cost and availability are definite problems. Also the ISDN debacle continues to haunt the minds of potential subscribers. Some have suggested (see the 1998 Harvard workshop at

www.ksg.harvard.edu/iip/ngct/ngct.html) that the Telcos would really like their DSL to be a mostly unregulated, non-common carrier service.

DSL availability is also tied up in the deregulation confusion from the 1996 Telecommunications Act that sets the scene for a clash between the normally state regulated telephone services and federal laws and regulations. Access to these services by ISPs and Competitive Local Exchange Carriers (CLECs) continues to be a problem. Telcos, despite recent Supreme Court decisions against them, continue to litigate against (and thus delay) competitive service providers.

Cable Data Services

Cable services, while regulated, are not common carrier services. This means there is no ISP choice without extra cost. Some fear that small ISPs who shelter controversial free speech could thus be forced out of business. The issue is important enough to existing ISPs and "portals" that AOL is actively campaigning for these services to be "open", although they are not suggesting that they be assigned common carrier status. A coalition of advocacy groups for opening cable networks to any ISP may be found at www.nogatekeepers.org. Availability also continues to be a problem, partly because cable operators feel little competitive pressure to quickly offer broadband data service.

Some feel that the best way to get meaningful competition to the Telcos is to let cable operators "do their thing" without requiring them to open their services to competitors. Others feel that because the Telcos are under pressure to open their systems to competition, it is only fair to place the same requirement on cable operators.

While subscribers may always discontinue service, the use of non-standard "modems" means that an equipment investment inhibits transfer to another type of service. Also, the cable companies would prefer to rent the interface device to you, which decreases competition. Possible standardization forced by the FCC is looming which would bring an element of competition to the sales of the interface equipment. But until universal (DSL, Cable, Satellite, etc.) interface devices (similar to the universal handsets which have been lacking in the United States' non-standard digital cellular situation) become available, the requirements for investment in fairly costly interface devices constrain ISP choice.

Another current policy issue is industry mergers as typified by the AT&T/TCI merger. AT&T will get access to homes over TCI's cables and can begin to offer competitive telephone and other services. A side issue has been the attempts of some local governments to deny approvals for the "new" TCI until they open their systems to competition.

Satellite

Costs and competitive issues are important. Satellite television services are about where cable television was a decade or more ago, but the adoption curve has reached the point of rapid increase. Satellite data services are in their infancy. The newness makes it difficult to predict where policy issues might surface.

As usual with a new technology, esoteric issues such as interactions between FCC

antenna regulations and local regulations limiting their placement will be discovered. Antenna placement regulations may be a particular problem for apartment and condominium dwellers whose antenna cannot “see” a desired satellite from their own window, balcony, patio or similar attachment point.

Terrestrial Wireless

Consumer terrestrial wireless data access is even less developed than satellite services. Issues include spectrum allocation, though a solution may in time emerge from the FCC's new debate on allowing ultra-wideband, micropower CDMA services. FCC rules (also cited above for satellite services) that restrict outdoor line-of-sight radio antennas, are another concern in some housing complexes.

Summary

Deployment of broadband data services is well underway. Significant, but not insurmountable problems exist. Perhaps the biggest is that this is all caught in the deregulation of telecommunications. For example, many industry analysts agree that Telcos' congressional lobbying before passage of the 1996 Telecommunications Act, and their litigation afterward, have impeded competition in the markets they dominate. In 1998, MCI and others suggested that to counter this, Telcos should be made to divest their copper loops. While there is now little interest in such drastic measures, continued failure to achieve local service choice for most customers could spur demand for them, and even for parallel steps against cable TV operators.

A special symposium sponsored by the Harvard Information Infrastructure Project called: “Next-Generation Communication Technologies: Lessons from ISDN” (http://www.ksg.harvard.edu/iip/ngct/ngct.html) was held in June 1998. While the overall results were inconclusive (everyone basically said “it wasn’t our fault”) there was a serious attempt to learn the lessons of this failed three-decade effort to digitize the “last mile”.

First, stable standards were very late, and their implementation later still ... yet for the residential customer who must rely on ISDN for both voice and data, important features are lacking even now. Among these are convenient extension telephones and easy interfaces to consumers’ existing analog Customer Premises Equipment (CPE) such as phones, answerers, auxiliary “ringers” (e.g., lights and gongs), wiring devices, etc. The market seemed to offer windows of opportunity in the early 1980s and again in the mid-1990s, but Telcos were too slow-moving to exploit these -- and some say that utility regulation left them little reason to do so.

Many states' ISDN tariffs also wrongly priced the service, as customers saw it. Telcos' chronically weak grasp of users' data needs, and their poor record in order handling and tech support, were further obstacles to success. And AT&T's 1984 divestiture sowed dissension among the companies that had to collaborate in order for ISDN to do well in the U.S. (The service won greater acceptance overseas.)

DSL -- and cable modem service as well -- are immune to some of the problems that beset ISDN, but vulnerable to others. Telcos and cable TV firms have had little success at selling and supporting advanced data services for consumers. This suggests that ISPs, CLECs, et. al., be helped to do so. But the incumbent owners/operators of wired

infrastructure in the U.S. typically disfavor such ideas.

Experience in Canada may be useful on this point. That country's counterpart agency to the FCC ordered that cable TV networks be opened to all data communication service providers who wish to serve cable modem customers. Many in the U.S. will observe these arrangements with interest.

Security and Privacy Issues with High Speed Internet Connections

Bob Ellis
Myles Losch

(Reprinted from Computer Graphics, November 1999)

There are two issues we didn't stress in our May report. Because most knowledge and experience is with DSL and cable modem service, we will restrict our discussion to those services. First, the "always on" (except if you turn off your computer!) means that you are connected to the Internet for potentially long periods of time with a static IP address. This means that "cracking" programs have ample opportunity to break into your system. In fact we know of a number of technically sophisticated home computer users who implement a firewall computer separate from the computer they use for processing. Such users report break-in attempts several times per hour. Given the low level of network security of the typical home computer, this means sooner or later such a break in attempt will succeed and possibly compromise the operation of and files stored on the computer.

A partially mitigating situation is the fact that most DSL providers assign a floating IP address each time you do reconnect. So if a cracking program has found something interesting on your computer, it will find a different computer after a new IP address is assigned. It is unclear to what extent cable TV Internet providers may adopt similar practices.

The other issue relates to the use of whatever local area networking software is commonly run on the subject computer to make the actual connect to the data service. This requires extra diligence on the part of the user to insure that others on the local area net do not have access to the computer. Microsoft Windows is a particular problem in this respect because the default local area networking parameters are set to share everything. This means, for example, that the people you are sharing your cable Internet access channel may have access to your files and even your printers unless the default settings are changed. Indeed, there have been reports in the popular press describing just such situations.

Finally, in our May report we provided a pointer to the group No Gate Keepers (www.nogatekeepers.org) which advocates that cable Internet services provide access to any ISP who wishes to gain access to their networks. At the time, we mentioned that there were groups advocating the opposite position: that cable Internet services should be allowed to continue to provide access only to self selected ISPs. One such group is NetAction (www.netaction.org). Note that NetAction's position is related to their interest in seeing competition in all aspects of consumer communications: entertainment delivery, voice and broadband data services. Cable networks are typically designed for only the first of these and require costly upgrades to support the other services. In order for cable

providers to do this, NetAction and others argue that it is reasonable to allow cable operators the freedom to provide non-voice services on their own terms. As you can see, this is a complex issue and thus broadband and other non-traditional cable services cannot be separated from telephony with its legacy of regulation.

Self-Installation of (Wired) Residential Broadband Internet Access

Myles Losch

(Reprinted from Computer Graphics, November 2000)

Among the obstacles to widespread home adoption of both DSL and cable modem services, has been the typical need for expert onsite technical skills furnished by service providers' field crews. Past attempts to let consumers self-install [in industry jargon, "self-provision"] such broadband links (as they would a dial-up telephone modem) fared poorly, due to technical and standardization problems.

But better technology, combined with quickly growing demand, has prompted new efforts to cut labor costs and delays by offering the customer an "out-of-box experience." Broadband access providers, with equipment makers and retailers, have developed (and cautiously begun to deploy) a new generation of streamlined industry standards for self-installation.

The research consortium Cable Television Laboratories (www.cablelabs.org) developed, and tests hardware compliance with, the DOCSIS (Data Over Cable Service Interface Specification) standard for cable modems. Phone companies' corresponding initiative for ADSL service, once called "G.lite," was standardized by the International Telecommunication Union (www.itu.int) as Recommendation G.992.2. This standard is being overseen by a new deployment consortium, OpenDSL (www.opendsl.org).

Retail packaging of both types of broadband access device is expected to take two forms: kits for use with separately purchased computers, and inboard versions pre-installed in both computers and fixed function "Internet appliances" such as Microsoft's Web TV terminals.

Industry analysts expect that such products, if successful, will do much to speed public acceptance of broadband Internet access. In future columns, we hope to assess the results.

Use and Protection of Intellectual Property (IP)

Barbara Simons

Copyright

Congress shall have the power ...

To promote the progress of science and the useful arts, by securing for limited times to authors and inventors the exclusive rights to their respective writings and discoveries.

User rights under Copyright

- First sale: I can give you my copy
  - Early 20th century publishers attempted to kill used book market by "licensing" a minimum price
- Fair use
  - for purposes such as criticism, comment, news reporting, teaching (including multiple copies for classroom use), scholarship, or research, is not an infringement of copyright.

Why Does Copyright Matter?

- Trade-off: limited time monopoly to encourage creativity and availability of information
- What if information becomes privatized?
  - Education
  - Democracy
  - Science

Technological protection for IP

- Technology will solve the problems created by technology => no need for draconian legislation?
  - What if technological "fixes" create as many problems as bad legislation?
  - Will fair use be defined by technology?
  - Could device manufacturers be sued for copyright violation?

UK/US History of Copyright

- Statute of Queen Ann (1710)
  - first recognized rights of creators
- US haven of copyright "piracy" in 19th century
  - Translations not covered until 1870
    - Harriet Beecher Stowe and German translation of *Uncle Tom's Cabin* - 1853
  - International protection not covered until 1891
    - Dickens *A Christmas Carol*
      - $2.50 in UK; $0.06 in US

Length of Copyright

- 1790: 28 years - originally 14 years
  ….
- Copyright Act of 1976: retroactively extended to up to 75 years after creation
- Sony Bono Copyright Term Extension Act 1998: extended yet another 20 years

ACM's Copyright Policy

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted with or without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and full citation on the first page . . . . To copy otherwise, to republish, to post on services, or to redistribute to lists, requires specific permission and/or a fee.

The DVD Controversy

The DVD Controversy

- DVD movies encrypted using Content Scrambling System (CSS)
  - Weak encryption
    - 40 bit key
    - proprietary algorithm
- Uses authentication to verify that player or operating system has been licensed
- Who can license open/free software systems?

CSS Broken - DeCSS

- Many people both inside and outside the U.S. involved anonymously with breaking CSS
  - DeCSS: one such program
- CLAIM: DeCSS needed to play legally purchased DVDs on Linux
  - Linux is widely used open source software
  - License for CSS includes non-disclosure
    - non-disclosure inconsistent with open source

MPAA v. Eric Corley A/K/A "Emmanuel Goldstein" and 2600 ENTERPRISES, INC

or

the 2600 DVD Case

Legal Case against Corley

- Lawsuit brought by Motion Picture Association of America (MPAA)
- Corley accused of posting DeCSS
  - Not accused of deriving DeCSS from CSS
  - Not accused of making illegal copies
- Corley subsequently deleted DeCSS from his web site, and instead posted links to other sites containing DeCSS

Arguments used by Defense

- Reverse engineering for compatibility allowed under DMCA
- Fair use guaranteed by copyright
  - Should not be able to eliminate indirectly via legislation
  - If DMCA holds, techies who can break encryption will have fair use right, but no one else will … including most judges

DeCSS legally available

- DeCSS available in Ca case at cryptome.org/dvd-hoy-reply.htm#ExhibitB
- T-shirt with code available at copyleft.net/cgi-bin/copyleft/t039.pl?s1&back
- This information available in published articles

Trial results

- Judge ruled against Corley
  - Enjoined from posting DeCSS
  - Enjoined from **linking** to other sites with DeCSS
  - Case being appealed
- DeCSS can be legally published off-line, printed on tee shirts, sung
  - why should rights be lost on-line?

Technological Approaches

Technological Issues

- Will technology undermine fair use?
  - No fair use possible under CSS for DVDs
  - *What does it mean for fair use to be legal but the development of tools to enable fair use illegal?*
- Even if allowed to develop circumvention tools for fair use, posting them illegal under DCMA
- If software sold on DVDs, how can you make backup copies?

Technological protection for IP

- Technology will solve the problems created by technology => no need for draconian legislation?
  - What if technological "fixes" create as many problems as bad legislation?
  - Will fair use be defined by technology?
    - Users prevented from accessing material or allowed to extract no more than x words, for some value of x.

Impact on Books

- What is a library?
- Will books eventually be encrypted?
- Will copyright be replaced by contract law?
- Will we have pay-per-view?
- What are the implications for economically disadvantaged individuals and countries?

The Players

- Supporters: Reed-Elsevier (world's largest publisher of scientific journals), Thomson (owns West Publishing, legal publisher), AMA (Physician's Desktop Reference), stock exchanges, esp. NYSE
- Opposed: Dun & Bradstreet, Bloomberg, AT&T, MCI, ALA, AAAS, USACM, Bell Atlantic, Academy Presidents, CSSP, ...

Issues

- Will technology undermine copyright?
  - No fair use possible under CSS for DVDs
  - What does it mean for fair use to be legal but the development of tools to enable fair use illegal?
  - Even if allowed to develop circumvention tools, it's illegal under DCMA to post them
  - If software sold on DVDs, how can you make backup copies?

Copyright legislation

Digital Millenium ...

- Outlaws reverse engineering except for compatibility, encryption & security research (with permission of copyright holder), privacy protection, and to protect minors against porn
- Since makes technologies or devices that are primarily designed for circumvention illegal, could criminalize some computer security R&D

Digital Millenium - definitions

- "Technological measure for protecting copyright"?
- "Effectively controls access to a work"?
  - Strong/weak encryption?
  - Data compression?
  - Obscure human language?
  - Compilation? Could decompilation become illegal?
- "Primarily designed" for circumvention?
  - VCRs? Breaking encryption?

Digital Millenium Criminal Penalties

- Circumvention of "copyright protection" or of "integrity of copyright management information" for commercial advantage or private financial gain:
  - first offense: <= $500K or <= 5 years prison, or both
  - subsequent offenses: <= $1M or <= 10 years prison, or both

Digital Era Copyright Enhancement (Boucher/Campbell)

- Prohibits altering or deleting copyright management information for purposes of infringement
- Prohibits enforcement of terms in "shrink-wrap" and "click-on" agreements when they reduce privileges recognized by copyright law
- Incorporates fair use and first sale rights

Digital Era Copyright Enhancement

- Ensures right of librarians & archivists to preserve copies of copyrighted works using latest technology
- Protects author's work under traditional legal understandings while allowing incidental copies for otherwise lawful use of a device.
- Civil rather than criminal penalties

Database legislation

Last year's Database Bills

- HR 354 The Collections of Information Antipiracy Act (Coble R-NC) - 1/19/99 Reintroduction of HR 2652
- HR 1858 The Consumer and Investors Access to Information Act (Bliley R-VA) 5/19/99

Comparison of database bills

- Both ban wholesale misappropriation of databases
- Differ on creation of new databases using material from existing ones (transformative use)

Problems with Coble (HR 354) Database Proposal

- Good for 15 years - updating resets clock
- Fair use: only extractions that do "not harm directly the actual market for the product or service"
- Protects "facts"
- Irreproducible databases e.g. astronomical observations

HR 354

- Prohibits the use of a "substantial part" of a database in many instances
- "...harm to the actual or potential market"
- Provides exemption for scientific and academic research that "does not harm directly the actual market"
- Other factors for exemption, e.g. "good faith"

Penalties - HR 354

- Criminal penalties: <= $250k and/or <= 5 years; second conviction both can be doubled
  - Doesn't apply if material in database > 15 years
- Civil action can be brought "without regard to the amount in controversy"
- Injunctions, impoundment of equipment, and monetary relief

HR 1858

- Aims to prevent harmful, parasitic copying while enabling researchers' access to information and continual development of value-added databases.
- Imposes narrow restrictions on the transformative use of information
- prohibits outright duplication of databases to compete against the original one.

Penalties: HR 1858

- FTC has authority to enforce
- violation of HR 1858 treated as violation of rule respecting unfair or deceptive acts or practices under Federal Trade Commission Act
  - Cease and desist order
  - <=$10K for each violation of order
- Civil remedies

Academy Presidents' Letter
(the WIPO database proposal)

"We believe that these changes to the intellectual property law, if enacted in their present form, would seriously undermine the ability of researchers and educators to access and use scientific data, and would have a deleterious long-term impact on our nations research capabilities. Moreover, the proposed changes are broadly antithetical to the principle of full and open exchange of scientific data espoused by the U.S. government and academic science communities, and promoted internationally."

The Players

- Supporters: Reed-Elsevier (world's largest publisher of scientific journals), Thomson (owns West Publishing, legal publisher), AMA (Physician's Desktop Reference), stock exchanges, esp. NYSE
- Opposed: Dun & Bradstreet, Bloomberg, AT&T, MCI, ALA, AAAS, USACM, Bell Atlantic, Academy Presidents, CSSP, ...

Uniform Computer Transaction Act (UCITA)

Formerly Uniform Commercial Code (UCC) Article 2B

Will apply to shrink-wrap licenses

UCC 2B/UCITA

- Purpose of UCC is to create uniform regulations of commerce in different states
- Article 2B would have applied to shrink wrap licenses
- Lawyers group withdrew but state commissioners continued and passed UCITA

Shrink wrap licenses

- Not required to be made available prior to purchase
- Not required to state conditions clearly and legibly
- Allowed to prohibit publication of product reviews or results of benchmark tests without approval

Software publishers may

- Disclaim liability for known bugs in product
- Refuse compensation for help-desk charges for defective product
- Notify customer of change of terms via email
- Turn off software if customer violates terms of license after email notification (proof of receipt not required)

Small Businesses

- Cannot obtain a refund if cannot see license until after purchase - and you reject terms
- Cannot transfer shrink wrap software if sell business
- Cannot hold software publisher accountable for statements of fact in manual

UCITA Opposition

- 26 state attorneys-general
- Federal Trade Commission
- Software Engineering Institute
- IEEE-USA/USACM (educational)
- American Society for Quality
- New York City Bar
- Librarians
- Insurance industry
- Sun Microsystems

UCITA Supporters

- Primarily software manufacturers and related industry groups

Where are we going?

- What is a library? What will happen to public libraries?
- Is copyright being replaced by shrink-wrap licenses?
- Will copyright be replaced by contract law?
- Will we have pay-per-view?

What You Can Do

- If you are a researcher or editor, obtain policy of publisher with whom you work
  - Copyright?
  - Fair use?
  - Pricing for libraries?

What You Can Do

- Be informed as consumer and producer of information
- Work on educating policy makers and the judiciary about the implications of various proposals on technology
  - Unintended consequences, e.g. criminalizing technologies that can be used for circumvention and the impact on computer security R&D

Digital Copy Protection

Robert Ellis
August 2001

This is a collection of articles that have appeared in the SIGGRAPH quarterly, Computer Graphics. The first article provides an overview of the topic. The second article is a review of a special section of the Communications of the ACM (CACM) on digital watermarking, which is a technique that may be used to provide copy protection. The third article reviews the situation with special focus on music, which many see as a precursor to issues associated with motion pictures.

Digital Copy Protection
Bob Ellis

(Reprinted from Computer Graphics, August 1998)

I've recently become aware of digital copy protection as an issue with impact on non-commercial digital recording. It was mentioned several times by attendees (there wasn't anything on the program) at the CFP98 Conference (reviewed in my last column). Member Myles Losch also brought it to my attention. I thought it might be an issue of interest to SIGGRAPH members. One comment made by a CFP attendee suggested that DAT devices have not been good sellers because the copy protection mechanisms limit their potential usefulness

Myles provided me with two useful references. The first discusses digital video standards to control intellectual property on DVD's and IEEE 1394 FireWire broadband links. Please see the DVD FAQ at http://www.videodiscovery.com/vdyweb/dvd (this discussion refers to the April 7, 1998 version that will probably have been revised when you read this). Myles says to note especially items 1.10 and 1.11, plus 2.10 on DiVX triple-DES cryptography and to also note items 1.12 and 3.6 on related audio work.

The second reference is at www.hrrc.org, a web site run by the Home Recording Rights Coalition. The HRRC provides information about legislation that addresses copy protection on recording devices. The HRRC was founded in 1981 at the time of actions relating to the legality of using a VCR to "time shift" broadcast television programs. It is frequently updated so I won't refer to specific items.

The advent of digital recording devices such as Digital Audio Tape (DAT) and Digital Video/Versatile Disc (DVD) has caused the owners of recorded intellectual property such as motion pictures and music to renew their concerns about unauthorized copying. Many you may remember the similar issue raised when analog audio tape recorders and VCRs first became available. Digital recording devices are an even greater problem for them because of the ability to make perfect copies, without the loss in quality when making

analog copies.

Typically, technical mechanisms are developed in industry standards committees to prevent copying and then legislation is proposed which would make it a crime to provide mechanisms to circumvent copying, rather than the actual act of copying. The problem comes when an authorized copy is to be made (for example, of material whose intellectual property rights are owned by the copier or copies made under fair use). If you make copies for a living, then you have an incentive to go through the hoops to effect the copy protection.

But if you are simply making a copy of your home movies, or results illustrating your computer graphics research, it might not be so easy. While many of the organizations do not want to prevent this type of copying, it is not their first priority.

Aspects of international treaties complicate all of this. Treaties in effect and proposed at the World Intellectual Property Organization may be much stricter in their interpretation of unauthorized copying than we are used to under current US law which has strong protections for fair use copying.

Note particularly, that some proposed legislation in the US prohibits the sale, manufacturing or use of any device that can be used to defeat copy protection. (This legislation has been passed as the Digital Millennium Copyright Act.) Current laws are directed at the actual act of unauthorized copying. Due to the rapidly changing situation, it's really not feasible to go into the legislative process in any greater detail here. I urge you to look at the references (particularly the HRRC site) and their links for the latest information.

USACM has been involved in this mostly as it relates to their stands on intellectual property and implementation of the international intellectual property treaties.

The DVD FAQ site has excellent descriptions of DVD technology in general. Section 1.11 describes four forms of copy protection used by DVD. Any or all of the schemes may be present on any particular DVD media.

The Analog Copy Protection System by Macrovision adds colorburst signals and pulses in the vertical blanking signal to prevent copying using composite video and s-video outputs. The copy generation management system (CGMS) embeds information in outgoing video signals. The content scrambling system (CSS) and Digital copy protection system CPS) both use encryption to prevent unauthorized copying.

Section 1.10 describes "regional codes", which can be used by content originators to control which parts of the world a DVD may be played. This means that a DVD purchased in one country might not be playable in another.

Section 2.10 presents a description of DiVX proposed by Circuit City. DiVX would permit the purchase of a DVD at a cost just above a one time rental and then play it once (perhaps with a time limit). Additional plays might require payment of additional fees. To effect the payment of additional fees and authorizations, a telephone connection to the player would be required. (DiVX proved to be unsuccessful and was withdrawn from the market.)

Like the legal situation, the technical situation is constantly changing, although not so rapidly. Still, it's not reasonable to go into greater detail here; again, I urge you to check the reference for current information.

Digital Watermarking
Bob Ellis

(Reprinted from Computer Graphics, February 1999)

Digital watermarking is the subject of a highly recommended (by me) special section of the July 1998 issue of the *Communications of the ACM (CACM).* Quoting from the Guest Editor's (Minerva M. Yeung) introductory article we see that "Digital watermarking is the embedding of unobtrusive marks or labels that can be represented in bits in digital content. The embedded marks are generally invisible (or imperceptible) but can be detected or extracted through computing operations and is why the are called "digital watermarks". The watermarks are bound to and hidden in the source data, becoming inseparable from the data (such as images and audio and video clips) so they can survive operations that do not degrade the data beyond its utility value in the intended applications."

"Data encryption and scrambling technology offer security for content delivery, as well as the means for controlling access and collecting revenues. But a key (in the cryptographic sense) to decoding or descrambling the encrypted or scrambled data will be available only to the content's (paying) patrons... Unfortunately, there is little, if any, protection for decrypted or descrambled content..." Thus digital watermarking is complimentary to encryption because it can protect non-encrypted material.

"Watermarks can also be used to communicate copyright, ownership, and usage-control information - even after format conversions and compression. Watermarking technology, if designed properly, can be used for proof of ownership, as a content authentication tool, and as a means of imprinting fingerprints into the data to allow tracing of the recipient should the data be misappropriated."

Individual papers in the issue cover topics such as: techniques, applications, needs of the content owner, content user, and attacker, benchmarking, performance evaluation, standardization opportunities, the business case, and market perspectives. While I believe that the technology is not yet fully developed, it shows significant promise, and its progress should be followed by all who are concerned about the identification and protection of digital media.

In an ideal juxtaposition of topics, the July 1998 issue of *CACM* also has a special section on Web Information Systems. Although perhaps not as much of interest to computer graphics professionals as digital watermarking, it does provide a timely overview of the subject in a series of short articles. Again, I highly recommend it.

Digital Copy Protection
Myles Losch

(Reprinted from Computer Graphics, August 2000)

Digital Copy Protection

Legal and policy disputes over protection of copyrighted works continue to slow the growth of digital television services, an important potential market for computer-generated imagery. Our last column noted a sharp increase in copyright lawsuits by music and movie suppliers, and this trend continues.

Many of the issues are the same for music as for visual content, and seem likely to be addressed sooner for audio, as we explain below. Graphics specialists would thus do well to follow closely the current "music wars."

Contributing to music's importance as a policy trendsetter are several factors:

1) Compressed audio can be transmitted and stored (at acceptable quality) using far fewer bits than video of equal duration.

2) Most popular music consists of brief songs, much shorter than typical video and filmed entertainment. This further reduces the technical difficulty and cost of handling such audio content.

3) A typical consumer's in-home access to the Internet will, for some years to come, be through relatively slow dial-up phone modems. Thus, online transmission is today more attractive (in general) for music than for visual entertainment.

One technically interesting byproduct of the litigation noted above, is a new generation of 'serverless' software for Internet distribution of audiovisual and other content. These decentralized systems (e.g. Gnutella) seem designed to present few attractive targets for potential copyright lawsuits.

But given the widespread infringement attributed to such products, the effectiveness of this strategy remains to be seen. And as for the ongoing court cases, few have yet produced clear policy results.

One possibly relevant exception, though from cases unrelated to copyrights or other intellectual property, is the view of a growing number of U.S. federal appeals judges that computer software is a form of free expression entitled to strong constitutional protection. If upheld in future decisions, this result could impede attempts to suppress controversial programs, or to mandate the features of software (especially freeware).

For more policy materials on digital copy protection (particularly of music, but also relevant to visual works), readers may find these online analyses helpful:

a) (From an Internet news service) http://news.cnet.com/news/0-1005-201-1757865-0.html

b) (From Newsweek magazine) http://www.msnbc.com/news/413376.asp

c) (by Harvard law professor William "Terry" Fisher) http://www.law.harvard.edu/Academic_Affairs/coursepages/tfisher/Music.html

Convergence of Computing and Television

Myles Losch
Robert Ellis
August 2001

Convergence of Computing and Television: Food for Thought

Myles Losch

"... People will be canceling their Internet accounts because they can get most of what they want on interactive TV ..."

Mark Snowden, Gartner Group senior research analyst for Internet and new-media businesses (quoted in "Daily Variety" for April 20, 2001 - page A2):

In this part of the course, we examine the idea that computing and television are on converging paths. But our opening quote reminds us that some (e.g. in the entertainment industry) don't see open platforms and networks (as in the PC and Internet models) meeting the needs of their audience.

Although the 'Net may be (as a U.S. court noted) "the most participatory form of mass speech yet developed," others see it and the PC as the Wild West, full of disturbing content, buggy and crash prone, user-hostile, beset by email spam, copyright "piracy" and computer viruses, and ill-suited to deliver a consistent, high-quality in-home experience, be it for shopping, entertainment, education, etc.

To such observers, open platforms and networks may ease development and testing of new mass market services and concepts, but will not (and should not) achieve the near-ubiquity of the telephone, refrigerator, radio broadcast receiver, and similar home appliances. Instead, such people look for a carefully controlled introduction of computing technology into traditional product categories, yielding "smart," more functional, and easier-to-use devices.

Let's keep that school of thought in mind as we begin a brief survey of computing-TV convergence.

Visions of Convergence

The uses of television technology are very diverse, e.g. as a scientific and engineering research tool, mass media entertainment, industrial monitoring, security surveillance, theatrical motion picture production, medical diagnosis and therapy, business and personal communication, education, etc. For each application area, much could be said about the convergence of video and computing technologies, but in this brief course, we focus mainly on entertainment TV (whether viewed at home or elsewhere), because:

1) It is of professional and/or personal interest to most S2001 attendees, and

2) As a potent mass medium, its development interacts with many facets of public policy.

Within the realm of video entertainment, we again find many applications and usage scenarios, e.g. video gaming, on-demand viewing of user-chosen films from a library, portable and mobile uses (e.g. with displays built into airliner seatbacks), and in-home networking (with, e.g., video recording and broadband access devices shared among TVs, PCs, local wireless displays, etc.).

A key element in most of these examples, is the freedom to transparently use a single display for any purpose, from bill paying to movie viewing, and in any location. This has posed a technical challenge because traditional TV images and displays are not only analog, but vary in their technical standards from country to country, while computer monitors, too, diverge in their resolution and other specifications.

Moreover, there have historically (and in part for good reasons) been key differences between computer and TV displays as such, with the former using square pixels and a progressive (sequential) scan to 'paint' CRT screens, while the latter used non-square (rectangular) pixels and an interlaced scan of the video raster.

Motives for Convergence

As we just saw, the technological obstacles to achieving "universal" consumer displays have been substantial -- but so too have been the incentives to pursue that vision. For example:

1) Cost: Since the 1950s, engineering and manufacturing advances have sharply cut the cost (and raised the quality and service life) of home television picture tubes. Since the 1980s, home PC displays have followed a similar trajectory. But in response to these trends, U.S. consumers have increasingly purchased large and costly 'home theater' displays, for a more immersive TV viewing experience.

Likewise, PC buyers have acquired growing numbers of portable computers that use costly liquid crystal flat-panel displays. Thus customers, instead of simply 'riding the CRT cost curve' downward (and pocketing the resultant savings), have often "traded up." That in turn boosts the economic incentives for industry to work toward all-purpose or 'universal' electronic displays, which let customers realize greater value from their investments in display hardware.

Nor are displays the only costly item driving convergence. Upgrading the world's telecom networks to support 'last-mile' broadband access from homes and small businesses is hugely expensive. By allowing these networks to carry multiple service types concurrently to a household (e.g. entertainment, telework, distance learning, etc.), more revenue streams can be generated to recover network upgrade costs faster, thus speeding the broadband rollout. Contrast this scenario with the historic single-service telephone and cable TV networks.

2) Physical Space: In densely populated Europe and Japan, household living quarters are often far more space-constrained than in North America. Thus even if cost were not a

factor, the space saving benefits of 'universal' displays would give convergence a further, powerful appeal.

3) Energy Efficiency: Even if display cost and size did not weigh in favor of convergence, operating cost would. And given global resource, logistical and environmental concerns (including climate change), economizing on power consumption is yet another goal that favors versatile displays.

4) Visual Realism: Turning from economic to functional considerations, the history of electronic displays (for both TV entertainment and home computing) has been marked by a continuing quest for more vivid, detailed, and indeed photorealistic imagery. Apple Computer's new OS user interface well illustrates this trend on the computing side, as does HDTV for entertainment (with its crisp, wide-screen picture format).

Nor is this a recent departure. The evolution of computer displays from text-only monochrome to bit-mapping and color, and TV's move from black-and-white to color (and perhaps someday to stereoscopic 3-D) parallel earlier changes in theatrical motion picture exhibition. Corresponding audio improvements are omitted here for brevity's sake.

As the technical challenges mount to achieve successive quality upgrades, and as the perceived results converge, it makes ever more sense to avoid 'reinventing the wheel' by sharing technologies and standards between the worlds of TV and computing.

5) User Control: The vast field of human factors engineering, and in particular user-interface design for electronic systems and services, has shifted decisively toward software-based models (that exploit visual displays) over recent decades. Commercial document-copying machines are a noteworthy example.

This is equally true for home entertainment products like TVs and VCRs, for the banking industry's automated tellers, for some motor vehicles, and for sophisticated public telephones. By moving from physical to virtual pushbuttons, control knobs, slide switches, etc., and by making other systemic changes (e.g. VCRs that self-set their internal clocks from a time signal), ever more intricate features may be managed by ordinary users while manufacturing costs are kept in check.

In consequence, growing amounts of computer technology are becoming embedded in devices that in other respects differ greatly from "computers." And while these are far from being "open platforms," they can allow for meaningful personalization while remaining immune to "malware" and other perceived drawbacks of general purpose PCs. Here, then, is still another front along which TV-computing convergence is advancing.

Roots of Convergence

1) Japan's Analog HDTV: We previously noted the technical evolution of home entertainment television, which began in the 1930s with monochrome BBC broadcasts at barely 400 lines of resolution, to the modern (1960s) European 625-line color signal formats (vs. the U.S.' older 525 line NTSC standard).

But as the underlying technologies continued to mature, it became clear that still further advances in image realism were within reach. Thus Japan's public TV network NHK three decades ago launched its HDTV development project. By the early 1980s this had yielded

thousand-line TVs, cameras, and other studio equipment, which was widely demonstrated to appreciative audiences.

Then in mid-decade "Japan, Inc." sought global standardization for its system, but European governments balked for protectionist reasons. As with aircraft (e.g. Concorde and Airbus), Europe considered it vital to retain a large internal manufacturing base for consumer electronics, and to avoid the fate of the U.S., whose once-healthy TV makers had, thanks to Japan's success in that field, been either bought by foreigners or forced out of business.

So Europe tried to hastily develop its own (incompatible) HDTV system, and in the previously complacent U.S., FCC officials in self-defense launched a search for alternative technology with which to block potential foreign domination of the (assumed) future U.S. HDTV market. Then to everyone's surprise, the FCC effort by the early 1990s yielded an engineering breakthrough: proof that a fully-digital HDTV system was not only possible, but could offer cost and versatility benefits over previous (analog) TV systems of equivalent resolution.

The FCC then sponsored development of a full, digital TV system that supported both HDTV and standard-definition image formats. And this in turn led to a largely successful effort by the computer industry (including SIGGRAPH - see appendix) to incorporate "computer-friendly" features (square pixels and support for progressive scan) into the new system.

2) Digitization of Electronics: A second historical trend contributed hugely to computing-TV convergence. From the 1930s (and into the 1960s), analog computers played a valued role in the solution of certain scientific and engineering problems. But before World War II, researchers realized that an electronic digital computer could potentially far surpass their analog machines. Wartime military funding made it possible to build the first such machines, thus launching the modern computer industry (and with it ACM, SIGGRAPH's parent organization, founded in 1947 as "the first society in computing").

About a decade later, Bell Labs' invention of the transistor found its way into computers, paving the way for the eventual spread of digitization to the broad range of electronic equipment, whether industrial, medical, telecom, military, consumer, etc. In the latter category, the first success took a further quarter-century, until the audio compact disc reached the market in the 1980s. But as noted above, yet another decade was needed before video could hope to "join the parade."

Forms of Convergence

1) Program Origination: Production and Post-Production

Many early TV shows were produced on motion picture film, due both to entertainment professionals' familiarity with that medium and to the absence (until the late 1950s) of videotape recorders for studio use. Film also had high spatial resolution, and was available in color, thus allowing shows that initially were broadcast in black-and-white to be "future-proofed" for reruns in TV's coming all-color era (widely foreseen by industry pundits).

Similar future-proofing goals led the music recording industry, in the late 1970s, to convert

to digital master-tape technology for studio sessions, thus anticipating the audio CD releases of the 1980s. So it isn't surprising, given Japan's early HDTV work, that a growing quantity of broadcast video content was produced in HD even before HD broadcast standards were set.

Adding to this trend is the recent introduction of "24P" HD studio cameras. Their progressive scan and 24-per-second frame rate were designed to mimic the esthetic qualities of movie film (which uses the same frame rate), thus gaining acceptance by a number of filmmakers whose work is destined for theatrical exhibition.

In post-production, the key computer-based innovation (which took hold during the 1990s) was the introduction of Non-Linear Editing (NLE) systems. This was truly a revolution in film and video editing, which permitted sharp reductions in the elapsed time for the editing process.

2) Delivery: Pre-Recording; Transmission: As with analog video, one can obtain digital video both live and pre-recorded. But here the parallels remain incomplete, due largely to public policy issues, which are more fully described below and elsewhere in this course.

For example, while DVDs are indeed digital video recordings, one cannot (without violating copyright law) view them digitally from stand-alone DVD players, even if one has a digital TV. Nor can HD yet be viewed from DVDs (due to hardware technology shortcomings).

Digital broadcast transmission over-the-air works fairly well (the FCC having turned back an engineering challenge to its standard radio signal format), but not (in general) via cable, since no rule requires it.

3) Reception and Viewing: As noted above under "Motives: User Control," computer-like user interfaces, based on firmware or software, are common in consumer devices for use with TV content (digital or analog), and contribute powerfully to ease of use and functional versatility. But with respect to time-shifting, archival, space shifting, capture of screen-shots and video clips (e.g. for personal home use, criticism, study and comment), digital video remains at a substantial disadvantage to its analog predecessor.

As noted below and elsewhere in this course, the reason for this discrepancy is that the foregoing 'fair uses' in the digital realm remain clouded by public policy controversies over the reach of copyright. When combined with equipment costs (slowly declining but still dauntingly high) and, as also noted above, a lack of pre-recorded and cable-delivered DTV programming (whether HD or standard definition), the consequence has been to slow DTV adoption to a crawl.

Two promising initiatives may address the problem of high receiver cost for DTV (and especially for HD). One of these, a possible regulatory mandate on TV manufacturers, will be considered below under governmental roles in technical standard setting.

The other approach is to exploit the installed base of HD-capable computer monitors, by using PCs as personal DTV sets. One firm, AccessDTV (www.accessdtv.com) sells $480 upgrade kits for desktop PCs, including DTV tuner cards and video recording capability via the computer's hard disk drive. But the copyright concerns noted above, led the vendor to block DTV playback through any other tuner card than the one which made a given recording. Thus, emailing of video clips (captured from free, over-the-air DTV

broadcasts) is not supported, despite its apparent lawfulness and potential value as a form of "viral marketing" for the DTV viewing experience.

Enablers of Convergence

Note: The history of digital TV (including mention of key technical standards that support "computer-friendly" imagery) was sketched above, in the "Roots" section. Our focus here will be on other factors that contribute to the potential for convergence of computing and television.

1) General Purpose Computers and Software (Open Platforms): Although multipurpose consumer appliances (whether electronic or not) have achieved modest success, most appliances are highly optimized for a narrow set of tasks, and cannot easily be turned to uses their designers failed to provide for. This tight focus brings clear benefits including ease of use: wired home telephones, for example, are said to be designed for five-year-old children.

If home computers were of this nature, it would be absurd to imagine (as previously mentioned) turning them into TV sets with built-in video recorders. Indeed, the history of (e.g.) dedicated word processing machines (in offices during the 1970s, then adapted for homes in the 1980s) makes it clear that computers' versatility has not always been regarded as a virtue.

But general-purpose computers are not merely versatile in the manner of a food processor or electric hand drill; they are (especially when built with option-card slots and loaded with suitable operating systems) truly "open platforms," or (to quote a 1980s advertising slogan) "power tools for the mind." And whether that mind be brilliantly creative or warped and destructive (or perhaps a little of both), the consequences of such openness can indeed be profound -- and inspiring to some, while alarming to others.

This characteristic, and people's diverse attitudes toward it, directly underlies a number of ongoing public policy debates, as the content of this course demonstrates. Whether the issue is cyberwar, digital copyright, covert employee surveillance, etc., open platforms provoke a mixture of excitement and concern to which older technologies seldom gave rise. (And as we'll see later, one response has been proposals to rein in or cripple computers and their networks.)

2) Integrated Microcircuits and Moore's "Law": While the potential for digital computers to process audiovisual information has always existed conceptually, it could never have become practical (let alone affordable in the home) without the striking advances (particularly since the 1970s) in ever-faster, ever-smaller, low-power electronic circuitry. Although this brief course cannot supply many details, the convergence we examine here is crucially based upon today's remarkable microchips.

3) Open Networks: What modern computers signify for individual users, the Internet (and any other networks with similar architecture) means to society at large. The "end to end" principle of the 'Net's design means that it, too, is an "open platform" on which geographically distributed applications (including entertainment distribution) can in principle be built by anyone, even if never specifically envisaged by the "fathers" of the Internet.

And for individuals, online software distribution allows one to benefit easily from the work of

distant software authors, with no need for physical contact. Since that holds equally for "transgressive software," the policy issues arising from open platforms (as previously mentioned) become all the more contentious in a networked context.

Constraints on Convergence

1) Global Standardization: In computing, technical standards are generally uniform worldwide. That is in part a result of decades of commercial dominance by a handful of U.S. firms, beginning with IBM. But a second related cause is the scarcity of governmental attempts to set such standards. In television, however, the opposite has been true, and this difference has clearly slowed convergence initiatives between these two fields, by multiplying the cost and engineering effort needed, impeding the cross border flow of video content, etc.

As previously mentioned, one reason for such technical differences in television systems is that different countries (or coalitions thereof) launched new services (e.g. color TV) at different times, and understandably wanted to benefit from the latest technical advances when doing so. Another reason for diverse standards has at times been...

2) Protectionism (Industrial, Cultural, Political): In recounting the history of HDTV, we previously noted how Europe (and later the U.S. also) rejected the Japanese analog HDTV system, fearing that it would entrench foreign dominance of their important consumer electronics industries. But television is more than a large, job-rich manufacturing industry; it is even more significantly a powerful mass medium.

As such, it has potential to dilute and debase a nation's culture, or alternatively to refine and elevate that culture. Countries that feared cross-border TV reception (and flows of TV content) as a threat to the survival of their national languages; as a bearer of alien religious teachings and cultural attitudes; or as a source of subversive political notions, thus had reason to head off such asserted evils by erecting artificial technical barriers along their borders.

Other means of 'defense' were even more popular, e.g. local-content quotas and language rules. The conceptual contrast with (relatively) standardized computers and a global Internet was clear.

3) Transmission Infrastructure (Wired and Radio): Since early television systems depended on broadcasting to reach viewers, governments' traditional control over radio transmitter licensing, siting, power levels, etc. brought with it crucial leverage over flows of broadband content to viewers. The introduction of new computer-friendly digital TV services in a country, usually required new frequency allocations, thus (in theory) increasing governments' leverage.

In the U.S., one result of this process was that analog TV broadcasters got new digital frequencies (channels), coupled with a requirement to give back their analog channels after a transition period. But no rules ensured that the transition would in fact end, thus placing in doubt the entire strategy.

In principle, these broadcast issues should not have mattered greatly, since most U.S. households use cable television for their TV reception. But government regulators did not require cable operators to carry DTV, so few did, and many a consumer's strongest

incentive for buying HD (or at least DTV) equipment all but vanished, taking with it some of the better prospects for an early U.S. convergence of computing and television.

Cable operators, to be sure, faced limited channel capacity on their networks, thus biasing them against early DTV carriage. This conundrum makes clearer the U.S.' lack of a viable DTV migration strategy, due in part to a political deadlock between government and the affected industries.

4) Copyright Issues: These are extensively covered elsewhere in this course, and to some degree both earlier and later in this "Convergence" section. Accordingly, we focus here on the relationship between copyright concerns and the "open platform" concepts previously presented under "Enablers of Convergence."

During the early stages of planning for Internet distribution and PC delivery of copyrighted content (including some video via broadband links), copyright holders have sought to deploy punitive laws against even arguably legitimate 'fair-use' copying of digital works. Concurrently, encryption and other access-restricting technologies have been applied to such works.

But the copyright industries now seem to believe that such measures will ultimately fail to yield the control over user behavior (with respect to copyrighted works) that they seek. Thus further restrictions are being sought, in the form of architectural changes to both PCs and the Internet, that would give both the ability to serve as hardware-based "trusted systems," immune to software hacking or subversion.

Such changes could convert PCs from true general-purpose machines into high-end appliances, with artificially crippled functionality. Some PC makers, however, apparently believing that their customers would reject such "dumbed down" machines, have refused to accede to "trusted system" changes. Unless laws are passed requiring such machine features, it thus seems doubtful that they will become standard anytime soon.

And so copyright interests are pursuing concurrently a 'fallback' strategy, based on the idea that if PCs are able to make unlicensed copies (however lawful), then valuable works must be offered only in digital formats and media that are artificially incompatible with PCs at the hardware level. Early examples are high-end optical audio disc formats, with HD videodiscs known to be under development.

This of course is exactly the reverse of the established approach, in which audio CDs and CD-ROMs (or video DVDs and DVD-ROMs) are, in computers, mostly interoperable members of a single storage-media family. Thus far, consumer response to this incompatibility strategy is too sparse to evaluate.

Governmental Roles in Convergence

1) Radio Spectrum Allocation: As previously discussed, advances in TV-computing convergence are linked to a transition of television technology from analog to digital. Whereas terrestrial radio broadcasters are expected to eventually achieve this by using "spare" capacity in their existing frequency assignments (to offer simultaneous digital and analog content), TV stations cannot do likewise, because of technical differences between the two media. Thus arose the U.S. arrangement (also noted previously) whereby TV stations would "temporarily," and free of charge, have use of two channels.

But although the FCC expects to auction TV's current analog channels for other (and increasingly urgent) needs of non-TV services, no plan as yet exists to ensure that analog TV's viewers will adapt their equipment for digital reception within some reasonable number of years. Until they do, it is politically infeasible for the stations' transition to physically complete, and for the analog channels to be vacated. We'll note below a promising idea for resolving this difficulty, which is a main (though not the only) roadblock for U.S. DTV service.

But financial problems also dog the DTV transition plan. For one thing, converting a TV station requires costly equipment purchases, from cameras to switchers, transmitters, etc. And while many of the prosperous urban commercial broadcasters have already equipped themselves, numerous small rural stations warn that they can't afford it. Worse yet is the financial picture for non-commercial public TV, except in a few major cities.

Nor is equipment the only financial drain. For HDTV origination, new and costlier scenery and stage sets, props, costumes, etc. are often needed too. That's because lower resolution analog TV (and to some extent digital Standard Definition TV (SDTV)) "hides" visual flaws that HDTV will reveal, negating in the minds of viewers the illusions which help to create the "suspension of disbelief" that's integral to effective storytelling. (And this isn't only an issue for drama and other performing arts; TV newsroom sets, etc. often give rise to similar problems.)

2) Technical Standards Adoption: As previously noted, FCC sponsorship was instrumental in the development not only of the U.S. DTV system, but of basic DTV technology that's now headed for worldwide implementation. This show of governmental initiative stands in contrast to, e.g., the FCC's refusal during the 1980s (under the influence of a dubious anti-regulatory ideology) to help the cellular telephone industry plan an analogous transition to digital services. (That contributed to a standards war that Balkanized the U.S. digital cellular market, unlike that of Europe and other world regions, to the detriment of everyone concerned -- including the public.)

Skeptics rightly note that despite the above, it has yet to be proved that viewers will actually pay to equip themselves to watch DTV. But incoherent transition planning seems to have contributed more to that, than any clear rejection by the public. Now, though, an idea has finally surfaced to make DTV happen in the U.S. without needless pain for the viewer.

This proposal would have the FCC require new TV sets (at first only the costlier, home theater models) to include DTV tuners. As economies of scale in tuner manufacturing brought down unit costs, that requirement would be extended in stepwise fashion to smaller and less-expensive TVs, until all new sets could display DTV (though not necessarily HD).

Among the advantages seen for this approach, is that it resembles the way in which, decades ago, UHF television broadcasting was successfully launched in the U.S. by requiring new TV sets to receive it in addition to the original handful of VHF channels.

3) Transmission Regulation: Governments have long imposed regulatory mandates on broadcasters with respect to program content and other criteria, whether the stations were profit-seeking or not. In some countries this included actual censorship, while elsewhere it focused on (e.g.) transmitter power and siting, community service, operating schedules,

reducing children's exposure to content judged harmful, etc.

With the rise of cable television (through which over two-thirds of U.S. households now receive TV), comparable regulatory regimes were devised for the cable TV industry. And as previously noted, the issue of DTV carriage over cable remains unresolved in the U.S., where it creates a major obstacle to the planned phase-out of analog broadcast TV services.

Perhaps the best resolution of this quandary may come through trends in transmission technology, and in particular a widely expected movement by cable operators toward hybrid fiber-coax (HFC) network architectures. By placing optical fiber terminals in served neighborhoods to feed the "last mile" (or less) of existing cable plant, HFC sharply raises the channel capacity of older cable systems. That in turn enables new digital TV services to be offered with less need to make room for them by displacing older analog channels, many of which are valued revenue sources to the cable industry.

HFC is also an increasingly important platform for the provision of broadband Internet access via cable modems, so its spread seems likely to be rapid despite the substantial associated costs for fiber terminal equipment and construction.

4) Copyright Policy Setting: Traditionally this governmental activity has been dominated by the industries directly affected, with little direct participation by, or obvious impact on, the public. But with the spread of digital media, public impacts are growing, and in democratic societies it is increasingly likely that public participation will follow, even if (in some countries) mainly through informal means such as marketplace behavior.

Other parts of this course, and earlier comments in this TV-computing convergence section, have sought to illuminate some of the relationships between copyright policy and modern information technology. Without trying to repeat that material, it can fairly be said that the quest for balanced policies, that suitably take into account the needs of all impacted segments of society, will be a long and challenging one, involving courts as well as legislatures and other organs of government. Much will depend on the outcome.

5) International Coordination: The relatively seamless global character of the Internet, and the history and traditions of the computing field, are notably at odds with television's basis in technical standards (not to mention content rules) that often differ substantially from country to country, and from one world region to another.

As previously mentioned, television has clung to this Balkanized tradition, mostly for various historical and protectionist reasons, in charting its transition toward a digital future. But some analysts expect this approach to be seen as increasingly anachronistic. If so, forward-thinking governments may figure importantly in moves to rationalize and coordinate possible TV advances (e.g. toward stereoscopic HD) across borders and oceans, at least with respect to non-cultural issues.

Appendix

Robert Ellis

SIGGRAPH letter to the FCC

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of Advanced Television Systems and Their Impact Upon the MM
Docket No. 87-268 Existing Television Broadcast Service

FCC 96-207 -- FIFTH FURTHER NOTICE OF PROPOSED RULE MAKING

COMMENTS OF
ACM SIGGRAPH
1515 Broadway
New York, NY 10036

July 10, 1996

ACM SIGGRAPH files these comments on July 10, 1996, in the FCC's Fifth Further Notice of Proposed Rule Making in the matter of Advanced Television Systems, MM Docket No. 87-268.

ACM SIGGRAPH is the Special Interest Group on Computer Graphics of the ACM. Our membership consists of approximately seven thousand professionals representing all aspects of computer graphics technology and applications.

Our primary comment consists of a copy of a letter written on behalf of ACM SIGGRAPH by Thomas DeFanti to Robert Sanderson dated October 18, 1993 (copy attached). The comments expressed in the letter regarding the desirability of progressive scan to support the graphics information on the NII are still valid.

What has changed is that the NII of three years ago has now become the Global Information Infrastructure (GII) whose graphics interface, the World Wide Web, has been responsible for millions of consumers gaining access to this communications medium of the future. If anything, compatibility with the graphics data on the GII has become even more essential in support of the convergence of television and computing that is rapidly occurring in the consumer products industry.

Submitted by:

Robert A. Ellis
Chair, ACM SIGGRAPH Public Policy Committee

Letter from Thomas A. DeFanti

October 18, 1993

Robert Sanderson
Chairman, Joint Experts Group on Interoperability
Eastman Kodak Co.
Bldg. 5, 4th Floor
1447 St. Paul St.
Rochester, NY 14653-7102

Dear Mr. Sanderson:

As you know, I represented ACM SIGGRAPH at last week's ACATS Interoperability Review in Washington D.C. I found the meeting to be extremely informative.

The ACM SIGGRAPH committee on ATV is adamantly opposed to any form of interlace digital HDTV output on consumer-level devices. We believe that progressive scan devices are the only feasible displays for information coming from the National Information Infrastructure (NII) and other computer-based services. We do not believe that interlace sets can be used in this context because one would either have to view a display with horrible interlace flicker (which is enough to make one turn one's head away) or halve the vertical resolution, yielding an impractical 32x9 aspect ratio for text and computer-generated image use. Furthermore, we believe that an interim standard allowing interlace would greatly impair the access to the NII by the segment of Americans who cannot afford both a computer display and a digital HDTV set. Thus, we are firmly against any interlace standard for even an interim period.

The Grand Alliance does not directly address the NII compatibility issue other than to point to the optional other progressive standards it is embracing. Allowing any interlace option is tantamount to eliminating the other options for our lifetimes, since a cheaper, non-compatible standard is embraced and produced first. The computer community I represent has spent the past 20 years suffering with the incompatibility of interlace television and computers. Now is the time to fuse computing and television by adopting progressive scan as the one acceptable method of display.

Requiring progressive scan on a consumer set does not, however, necessitate progressive scan cameras or broadcast. The consumer set will have enough memory inside it to scan out video in any way from signals received in any order. The consumer set simply has to display in progressive format so that it doesn't flicker unacceptable with NII-type information. Virtually all computers put out progressive scan and, eventually, cameras and broadcast equipment will follow. Consumer videocassette recorders (VCRs) could similarly feed a variety of compression techniques (including interlace) into progressive scan consumer sets, although interlace would destroy or cause any NII-type information to flicker.

We believe that achieving consensus on progressive scan and NII compatibility is so critical that any additional time spent debating the issue is well worth it. We urge you to continue the debate in good faith and examine all the issues, including the new ones brought up last week. This is not a time for haste.

Sincerely,

Thomas A. DeFanti

Chair, ACM SIGGRAPH Committee on ATV
Professor and Director
The Electronic Visualization Laboratory
Electrical Engineering and Computer Science Department
University of Illinois at Chicago
851 S. Morgan St., Room 1120
Chicago, IL 60607-7053

cc: Richard Wiley
Wiley, Rein & Fielding
1776 K Street NW
Washington, DC

Congressman Edward J. Markey
2133 Rayburn House Office Bldg.
Washington, DC 20515

Mary Whitton
Chair, ACM SIGGRAPH

Research Support

Robert Ellis
August 2001

Introduction

This topic was covered in the overview document. Here we present the definition of the proposed NRC CSTB study. This was written by Jerry Sheehan (NRC), Mike McGrath and myself. Seed funding from SIGGRAPH in the amount of $50,000 has been approved by the SIGGRAPH Executive Committee.

Research Challenges in Computer Graphics

Computer Science and Telecommunications Board
National Research Council

SCOPE

This project will identify areas in which additional research is needed to make computer graphics a more capable medium for supporting a growing body of work in areas such as health care, entertainment, product design and manufacturing, scientific visualization, and education. It will bring together computer graphics researchers with users from a range of application areas to derive a set of research needs and will attempt to identify key remaining problems to be solved in the field. In order to ensure broad input from the computer graphics community and user communities, the project will solicit participation through workshops, white papers and briefings. Indeed this process has already started: the final form of this document is the result of a review by key members of the computer graphics research community.

CONTEXT

Policy Context

Computer graphics is becoming a ubiquitous tool for interacting with information technologies. Although many feel that entertainment uses in video games, feature-length films, and Web pages dominate, computer graphics is increasingly being used to help doctors plan difficult surgeries, to enable engineers to create virtual mock-ups of large engineering projects, to help scientists interpret the results of scientific simulations, to help educators illustrate key concepts for their students, and to help monitor natural resources and environmental conditions. Graphics provides an accessible medium for users to interact with computing and communications systems and interpret data.

As the capabilities of computing and communications technologies continue to increase, improvements in generating, manipulating and displaying computer graphic images will continue to grow, enabling them to be used in an ever-broader range of applications.

Advances in this field will play an important role in the diffusion of information technology throughout society.

Despite the more widespread use of computers and the Internet by the general public, certain groups of citizens are underrepresented, creating what has been referred to as a "digital divide". There are many dimensions to the Digital Divide, but computer graphics has the potential to help many more people use computers and the Internet effectively by creating more capable users and modes of accessing information (SIGGRAPH 1997).

Ensuring that computer graphics capabilities will keep pace with advances in hardware and software will require continued research. As in the past, industry, academia, and government will have important roles to play in supporting this work. Industry supports considerable research and development in graphics, especially in support of entertainment, graphics production, and computer-aided design. But industry is generally not well equipped to support fundamental research that will develop broad graphics capabilities that may not mature for a decade or more. Industry's goals, traditions, and mechanisms for selecting R&D projects tend to select research that is more closely tied to immediate needs. Ensuring continued effort in fundamental graphics research will therefore require continued federal support of university research.

Federal funding has historically played a significant role in advancing computer graphics research. The Department of Defense provided critical, early support for university research in the basic techniques for modeling solid objects, shading, and virtual reality that are used today (CSTB 1995). Other federal agencies, such as the Department of Energy, National Aeronautics and Space Administration, and the National Institutes of Health have supported projects to extend computer graphics capabilities into particular mission areas, such as weapons simulation, scientific visualization, biomedical imaging, manufacturing design and analysis, and the global information system. The National Science Foundation has also funded computer graphics and in 1991 established a Science and Technology Center for Computer Graphics.

To date, most federal support for computer graphics has been provided on an ad hoc basis, with little long-term program support or planning. Perhaps in part because computer graphics is frequently not seen as a real branch of computing research, each agency has tended to sponsor work in its own area of interest. As computer graphics expands into a widening range of application areas, such fragmentation of support is likely to proliferate, leading to the possibility that the potential benefits of computer graphics will not be fully realized. Indeed, a 1997 review of the National Science Foundation's Science and Technology Center in Computer Graphics (NSF 1997) recommended that the NSF work with the National Research Council to identify the broader scope of research that remains to be done in computer graphics and to communicate this information to policy makers, but this recommendation has yet to be implemented. The surge in information technology applications since that time makes the need even more compelling today.

Technical Context

Research in computer graphics encompasses a broad range of topics, including modeling, rendering, interactive techniques, and graphics hardware. *Modeling* consists of techniques for creating computer-based representations of objects and scenes to be depicted. *Rendering* is the process of producing images for display on a monitor or printer. *Interactive techniques* include tools and physical devices that permit the

development of applications that allow human users to interact with graphical representations in real time. *Graphics hardware* consists of specialized and general-purpose hardware for creating and displaying computer graphics. It ranges from high-end workstations and desktop PCs augmented with graphics accelerator cards for carrying out graphics calculations to specialized user interfaces, such as helmet mounted displays for virtual reality or augmented reality experiences.

Advances in these core areas will be needed to enable faster, simpler development of realistic and complex computer graphics images such as those found in increasing abundance in the growing collection of digital libraries. Research will also be needed to help tailor these fundamental advances to particular application areas, whether healthcare, entertainment, or scientific research. Such efforts will require collaboration between computer science researchers and those in other disciplines such as art, engineering, and medicine. We have specifically not defined the scope of computer graphics in detail in order to allow study members great latitude in their work.

In addition, future research in computer graphics will respond to new opportunities created by the increasing capabilities of computing and communications systems. For example, work on the virtual reality markup language (VRML) is enabling the creation of three-dimensional images that can be incorporated into pages and shared over the World Wide Web. Future work could extend these principles to allow large scale virtual environments to be shared via the Internet. Image-based rendering techniques, which incorporate real-world or synthetic imagery into 3D databases, will provide more complex and realistic computer graphics and may transform rendering, modeling, and graphics hardware. Virtual reality and augmented reality systems will be experienced through all our senses, including sight, sound, and motion or touch.

Similarly, work on automatic data simplification and database re-targeting will produce the capability to take models created at a high level of complexity and deploy them at a lower level of complexity commensurate with available computing resources. Hence, a model created on a high-end workstation can be deployed on a notebook computer. Such work is particularly important with the advent of the World Wide Web where bandwidth is limited and complex models might overwhelm the infrastructure. While itself a research issue, development of the Next Generation Internet promises to allow increased collaboration among researchers in different disciplines and countries, many of whom will share graphical images and simulations.

PLAN OF ACTION

Statement of Task

A group of experts in computer graphics and its varied applications will identify compelling research needs in the field, highlighting those that promise significant returns due to the scope, scale, or breadth of their potential applications. The group will examine research needs in both core areas of computer graphics (such as modeling and rendering) and in application areas such as defense, entertainment, medicine, manufacturing, and scientific visualization to identify those research areas that can be leveraged broadly. The results will inform research-related activities in government, universities, and industry and provide guidance on the roles each entity can play in achieving the research objectives. We do not mean to imply that such a study entirely replaces the traditional bottoms up proposal driven

method of defining research areas.

Responsible Body

CSTB will assemble a study committee of 12-15 members to conduct this study. Membership will be drawn from industry and academia, and will include recognized experts with strong knowledge of core computer graphics disciplines and a diverse set of application areas. It will attempt to combine the perspectives of computer graphics researchers, artists, scientists, engineers, and others who use graphics systems to create different forms of imagery or content. Suggestions for committee membership will be solicited from CSTB members and staff, other relevant groups within the National Academies, the computer graphics research community, potential sponsors, and from recognized leaders in interesting application areas.

Although such a group cannot possibly represent all of computer graphics research and applications, committee members would attempt to solicit a wide range of input to help them identify the most pressing technical needs and biggest research challenges.

Preliminary Work Plan

Based on consultations among Board members, CSTB committee members, and the sponsors, CSTB will seek nominees for the study committee and suggestions for topics to address. The study committee will meet approximately five times over the course of the study to plan its work, meet with the sponsors and other relevant parties, prepare a summary report, and respond to review comments.

A workshop or series of smaller data-gathering sessions will be convened to solicit input on research needs from diverse communities of users. Should timing allow, a meeting or small workshop could be held in conjunction with the annual SIGGRAPH conference to facilitate broad participation of the computer graphics community. Additional efforts will be made to solicit input through white papers, briefings to the committee, and the Internet.

The committee would consider such questions as (1) How will advances in computer graphics enable significant breakthroughs in fields such as entertainment, health care, engineering design, manufacturing, and scientific research? (2) What technical advances and research are required to enable computer graphics to serve a growing range of needs? (3) What unsolved problems remain within the field of computer graphics and are they being adequately addressed? (4) What new capabilities do advanced computing and communications provide that may drive computer graphics applications? (5) How can the most promising research issues be best addressed? (6) What are the complementary roles of industry, government, and universities in meeting future challenges? (7) What are the benefits of research in different areas of computer graphics? To the extent possible, the committee will attempt to identify research topics of enduring interest and value and those with broad applicability.

Product and Dissemination Plan

The principal product of this project will be a report summarizing the findings of the study committee and articulating its recommendations. The report will be subject to NRC review procedures to ensure its accuracy, balance, and rigor. Dissemination will be targeted toward government policy makers, members of the computer graphics research

community, and key users of computer graphics systems in industry, academia, and government. The report will be made available on the National Academy of Sciences World Wide Web server, as well as in paper form. Additional efforts will be made to disseminate the report's conclusions through briefings to interested parties in government, academia, and industry; through participation in high-level government and industry conferences; and by publication of summary articles in relevant journals, as appropriate. Funds for dissemination are included in the budget. In the final analysis, the success of this project will be determined by whether the daunting goals of increased awareness and funding for important elements of computer graphics research happens.

REFERENCES

CSTB 1995. *Evolving the High Performance Computing and Communications Initiative to Support the Nation's Information Infrastructure*. National Academy Press, Washington, DC.

NSF 1997. *Review of the Science and Technology Center for Computer Graphics*. National Science Foundation. Arlington, VA.

SIGGRAPH 1997 "Computer Graphics, Visualization, Imaging and the GII (Internet)", SIGGRAPH White Paper #1, Gershon, et.al., May 1997 (www.siggraph.org/pub-policy).

Overview the Public Policy Process

Robert Ellis
August 2001

Introduction

This is an overview of public policy in general: how it is implemented and influenced, the roles of various players and the area of professional public policy activities.

How Public Policy is Implemented

The implementation of public policy obviously varies greatly among political entities. But certain fundamentals tend to be universal. Generally public policy is a statement of goals and directions. There is no concrete effect until the stated policies are actually implemented. Implementation generally means reducing the general statements of policy to concrete form, usually as laws or regulations.

In most political entities, there are three ways policy statements get transformed into laws and regulations. The most direct is by legislative action. The political body responsible for enacting laws introduces prospective laws (frequently called *bills*) and then by deliberation and voting, turns the prospective laws into actual laws. In this process, the prospective laws are likely to be changed considerably.

The administrative part of a political entity is generally responsible for carrying out the directions in the laws passed by legislation. This may take the form of developing regulations for the conduct of personal and public activities. In many places, the administrative entity also may initiate the passage of new laws. This generally takes the form of developing new policies and then getting them introduced into the legislative process.

There is also a third entity responsible for setting policy. The courts interpret the laws and as such, may effect drastic changes to the content or interpretation of laws and regulations.

How Public Policy is Influenced

The political entities described above do not operate in a vacuum. In many governments, the citizens elect some or all of the people constituting the three political entities. Some may also be appointed possibly with the consent of citizens or one of the political entities.

It is important to remember that representative forms of government were developed because the size of the represented group is too large to function effectively as a committee of the whole. As much as we might admire the direct democracy of ancient Greece or the New England town meetings, they are not generally a very efficient way to

govern. This means that representation works in the other direction: elected representatives simply do not have the time to listen to everyone they represent.

Elected representatives generally listen to three types of people: campaign contributors, representatives of organized groups and constituents. All of these categories are important and if you are attempting to influence policy you must determine in which role you can operate most effectively.

The role of campaign contributors in influencing public policy is well known. As the cost of getting elected continues to increase in many countries, most elected representatives must spend considerable time soliciting funds. The contributors of these funds get listened to. This is not necessarily bad, but it can lead to abuse.

Representatives of organized groups get listened to because of the size and importance of the groups they represent and the quality of what they have to say. Most organized groups have a bias. This too is not necessarily bad and is usually easily recognized by the people listening to them. Quality information can frequently be presented by even the most biased of groups.

Constituents are probably the most influential of all the groups. No matter how much campaign money an elected representative has or how many powerful groups they please, they must ultimately get the approval of the people they serve. Although this idealized concept may be somewhat distorted in practice, constituents still have a lot of power.

Meetings with policy makers and/or their staffs are generally the most effective way to influence policy. This may require the use of public policy professionals (see below) to gain access. Telephone calls letters and faxes are also effective, although unless the caller is an important person, the communication will probably be received and acted upon by a staff member. The effectiveness of the communication is generally directly proportional to the effort and thought that went into it.

Massive email campaigns are generally not effective. After all, policy makers, like most of us, do not like to be overwhelmed by unsolicited email. However, email can be an effective tool for following up previous contacts.

Finally, the most important aspect of influencing policy is to remember that timing is everything. Contact before an issue is under active consideration is likely to be ineffective. Contact after an issue has been decided is most defintely a waste of time.

The Role of Technical and Professional Societies

Technical and professional societies such as ACM and SIGGRAPH can play an important role in the public policy process. They can inform their members, which presumably have common interests, of policy issues that might affect their professional and personal activities. These societies can also provide information to policy makers, although this requires more capability and effort than informing their members, something they usually regularly do.

It is possible that these societies can also take and advocate positions on policy issues. However, they must be careful to make clear whether they are representing the members of the organization or not. If the organization membership is fairly homogeneous and the

organization's positions are well know, it is probably reasonable to develop positions on a rather informal basis. An organization might also have a body that develops positions. Finally an organization may have its members vote on the positions to be taken. On the other hand, officials of an organization may take a personal position based on their knowledge of the subject matter and general knowledge of the membership, although they should be careful to make this clear when presenting these positions.

The Role of Professionals

Professionals in a field can make an excellent source of information for influencing policy makers. Unless the professional is a widely recognized expert in the field, they will be unlikely to gain direct access to policy makers. The best way to make your expertise known is to work with some group and/or policy professionals to gain the appropriate access. You may only be able to be heard by the people in your group, but timely and accurate information is always welcome.

Formal testimony is always an important role for professionals. It requires careful analysis and presentation. Effective presentation skills are also necessary. People selected for presenting testimony are usually recognized experts in their field.

One other activity for a professional is to perform outreach to the general public. The appendices contain some material I've used in this activity. My experience is that this is most effective when you can get yourself on the program of an existing organization that has regular meetings. Like everyone, most members of the public are busy people and the subject of your concern may be pretty far down on their list of things to worry about! Just talking with your friends, neighbors and relatives can be very effective. Remember to make your comments relevant to their interests and be sure to listen to their comments.

The Role of Citizens

All professionals are also citizens and unless you're a widely recognized expert, this is likely to be the most effective hat to wear when contacting policy makers or commenting on an issue. In writing a letter to the editor of a general interest publication such as a magazine or newspaper, this is also an effective role to play. When writing a letter to a publication remember that the letters most likely to get published are those that are responding to something that previously appeared in the publication.

Public Policy Organizations

As you might expect, public policy has become a business complete with specialized organizations and its own set of skilled professionals. Many of these organizations focus on a single policy topic, but others cover several related topics. Others are organized primarily for non-policy purposes, but do policy work as a related activity. These organizations represent individuals, businesses, industry groups, special interest groups and other categories too numerous to mention.

Many of these organizations have a strong presence in capital cities and many have a staff of policy professionals. These professionals come from many backgrounds such as the law and political science. Some are registered lobbyists, but many are not. Their job is to establish contacts with policy makers, track policy and governmental activities and decide on the best time to contact policy makers on specific issues. They can be a valuable

resource to those of us who work on policy part time.

ACM has a small office in Washington DC which represents ACM's US Technology Policy Committee. It has a small staff. SIGGRAPH has no office anywhere and only volunteer participants.

Web Resources

As with so many other topics, almost everything worth knowing about most public policy issues is available on the web. Most government entities and organizations working on policy have active web sites. Putting a search term such as "Privacy" or "UCITA" in a web search engine will turn up pointers to many worthwhile governmental, organizational and news sites.

As with any other website, it's very important to know exactly who is behind the site. For example, the Home Recording Rights Coalition sounds like it might be a consumer organization, but it is primarily sponsored by companies that make consumer electronics products who believe that being able to make copies of digital content is important to the success of their businesses. In many ways, this is aligned with the desires of consumers, but not always.

Disclaimer

The author is not an attorney and the material in this work should not be considered legal advice. The material is the personal opinion of the author. References to certain URLs contained in this work are provided as a service to the reader. Their presence should not be interpreted to mean that the author either supports or endorses the referenced material. Due to the dynamic nature of the Internet, the author cannot guarantee that these URLs are still valid at the time of this reading.

The author has made a best effort to determine the validity of the material at the time of writing, but makes no claims as to its continued validity.

About the Author

Robert Ellis retired in 1993 as Sun Microsystems' representative on the Technology Committee of the Computer Systems Policy Project (CSPP - an industry policy study organization) and co-manager of Sun's university research program. Previously, he held computer graphics software development and management positions with Sun, GE-Calma, Atari, Boeing and Washington University (St. Louis, MO). He received BS and MS degrees in Electrical Engineering and Computer Science from Washington University (St. Louis). Ellis currently does work as a volunteer for technical societies; he is a member of the Association for Computing Machinery's (ACM) US Technology Policy Committee (USACM) and serves as the Chair of the Public Policy Program of ACM's Special Interest Group on Computer Graphics and Interactive Techniques (SIGGRAPH).

Appendix I

This is the document used to determine if there's interest in a presentation.

Computers, Public Policy and You

Bob Ellis
January 2001

As the general public's use of digital technology (computing, recording (CD, DVD, etc.) and data transmission (Internet, HDTV, etc.) has dramatically increased, governments at all levels have been rapidly passing new laws and the courts have been busily interpreting these and existing laws. Many of these new and existing laws directly impact what you can and cannot do with this new technology, even for your personal use. This presentation explores the impacts and what you can do to influence the developing public policy in digital technology.

This material can be presented as a single presentation or as a multi-session course. The presentation format is a 15-minute to one-hour overview of these issues. The course format is a one-hour session on each topic with out of class study of web references.

Prerequisites

There are no formal prerequisites, but an interest in public policy and an understanding of the use of digital technology are useful. Only minor knowledge of digital technology is required. Internet access is required for accessing the course reference material.

Outline

Who can read my email, access my computer files and how can I protect my data and privacy? If I can protect my data will criminals and international terrorists also do this and how will law enforcement agencies deal with the new options?

You mean I don't actually own that software program I just bought and installed and I can't do whatever I want with it? Can I legally own copies of MP3 music files and can I trade them with others? What's all this fuss about Napster and Gnutella? What can I legally do with copyrighted material I download from the Internet? Why can't I get an Internet domain name that's the same as my business?

Why can't I make a copy of the DVD movie I own or even have access to the digital format?

Is it safe to use my credit card to make purchases on the Web? Will I ever have to pay sales taxes on my Web purchases? What can organizations on the Web do with the personal information I supply?

How can I protect my children and grandchildren from objectionable material on the Web when the courts keep throwing out the laws passed to protect children? What are the limits on material I can download and store on my computer? How can gambling websites operate when it is illegal in the US to transmit gambling information over telephone lines?

Can my neighbors really access my computer files and print on my printer if I use one of the new high speed Internet connections? How do these new services differ from my plain

old dial up access?

When will I be able to buy an affordable High Definition TV (HDTV)? When will I *have* to buy a HDTV set? Will I still be able to record HDTV programs for my own personal use?

Why is the government picking on Microsoft? Why does the government need to fund computing research with all the rich computer companies out there? What's this Digital Divide I keep hearing about and why is it important to me?

If I don't like how things are going, what can I do about it?

About the Presenter

Bob Ellis and his wife have lived in XXX since 1995. Bob retired in 1993 as Sun Microsystems' representative on the Technology Committee of the Computer Systems Policy Project (CSPP - an industry policy study organization) and co-manager of Sun's university research program. Previously, he held computer graphics software development and management positions with Sun, GE-Calma, Atari, Boeing and Washington University (St. Louis, MO). He received BS and MS degrees in Electrical Engineering and Computer Science from Washington University (St. Louis). Bob currently does work as a volunteer for technical societies; he is a member of the Association for Computing Machinery's (ACM) US Activities Committee (USACM) serves as the Chair of the Public Policy Committee of ACM's Special Interest Group on Computer Graphics and Interactive Techniques (SIGGRAPH).

Appendix II

This is the handout that goes with the presentation.

Computers, Public Policy and You

Robert Ellis
February 2001

Copyright © 2001 by Robert A. Ellis. Permission to make digital or hard copies of all or part of this work for personal or educational use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To otherwise copy, republish, post on servers or redistribute in any manner requires specific prior permission.

As the general public's use of digital technology (computing, recording (CD, DVD, etc.) and data transmission (Internet, HDTV, etc.) has dramatically increased, governments at all

levels have been rapidly passing new laws and the courts have been busily interpreting these and existing laws. Many of these new and existing laws directly impact what you can and cannot do with this new technology, even for your personal use.

For example, in the pre-digital days you could access copyrighted printed material by simply buying a book or checking it out of a library. You might copy a few pages for your personal use but it was considerable work, expensive and the copies were generally not high quality. In the digital age, just to read material downloaded from the Internet or contained on a CD-ROM, a copy must be made inside your computer. Once there, perfect copies can be made with little or no trouble and expense. This simple change has had profound effects.

Who can read my email, access my computer files and how can I protect my data and privacy? If I can protect my data will criminals and international terrorists also do this and how will law enforcement agencies deal with the new options?

Email travels through and is stored on may computers even after it has been deleted. Computer files can generally be read by anyone who has access to the computer either physically or via a network. Encryption technology "scrambles" file contents so that they can only be unscrambled by someone who has the mathematical "key". This works for files on your computer as well as files, such as email, sent over the Internet. Encryption is the first line of defense of your privacy. Protect your email address. Access web sites with "cookies" turned off. But remember, almost anything can and has been subpoenaed; computers have very long and accurate memories.

Smart criminals and terrorists all use encryption. Encrypted file can be opened without the key by powerful computers with the effort required depending on the length of the key. Escrowing systems for the keys by independent third parties and available to governments by court order (much like wiretaps) has been proposed, but there are many problems (e.g., how do you protect human rights organizations from totalitarian governments?). Snooping systems like the FBI's Carnivore can collect information subject to court ordered constraints.

You mean I don't actually own that software program I just bought and installed and I can't do whatever I want with it? Can I legally own copies of MP3 music files and can I trade them with others? What's all this fuss about Napster and Gnutella? What can I legally do with copyrighted material I download from the Internet? Why can't I get an Internet domain name that's the same as my business?

Unlike books, video and audiotapes and tangible goods, most software is licensed, not sold, and the rights of the licensee are controlled by the "shrink-wrap" or "click-through" license that can impose any constraints the licensor wants. Common constraints include not making copies, requiring licensor approval before disposing of the software, not analyzing the software, not writing articles about the software without the licensor's approval, etc. The legality of these licenses has been questionable, but a new prospective law, UCITA, attempts to change that.

MP3 is just a form of compression of audio data and is not illegal to use or have MP3 files. An MP3 form of copyrighted material is subject to the same rules as any other copy. Except for "fair use" you cannot copy, sell or perform in public any form of copyrighted material although you can give it away or even resell it (first sale doctrine). Fair use

derives from the U.S. Constitution. Fair use is generally defined as including making copies for personal, private or non-profit use, quoting in reviews or scholarly works, etc. Fair use is not precisely defined by statute.

Napster and Gnutella are systems for exchanging MP3 formatted files of data. As long as the work is not copyrighted or otherwise controlled and you have a legal right to share it, using Napster and Gnutella is not illegal. But it is easy to abuse these systems.

Copyrighted material you have legally downloaded from the Internet is subject to all the conditions listed above.

In the pre-Internet days, trademarks had a strong geographical and line of business separation (e.g., Apple Computer and Apple Records). Although country and even further geographical domain names exist, everybody wants to be in the .com top level domain. Who has trademark rights - United Airlines, United Van Lines, and United)? Similar names (e.g., etoy vs. etoys) also cause problems. New top level domains (.biz, etc.) will probably just make it more confusing.

Why can't I make a copy of the DVD movie I own or even have access to the digital format?

DVD movies are weakly encrypted by a scheme called CSS and unless you have a way to unscramble the data (such as a computer program like DeCSS), there is no way you can get a viewable picture. A technology also prevents making VHS tape copies of the analog signal. In addition, there is no digital output data stream from any device that has been manufactured under appropriate license arrangements. The only way currently to see a DVD movie in digital format is on a properly configured laptop computer.

Is it safe to use my credit card to make purchases on the Web? Will I ever have to pay sales taxes on my Web purchases? What can organizations on the Web do with the personal information I supply?

Making a credit card purchase on the web is somewhat safe if the number is sent via a secure connection. But the number is usually stored on an Internet accessible computer and there have been many cases of crackers breaking into these computers and stealing the information. Normal consumer credit card protections apply to Internet transactions.

Current U.S. law says that a seller only needs to collect sales taxes on interstate commerce if it does business in the state where the purchaser lives. Most states have use tax laws that require you to pay an equivalent tax on goods purchased out of state. Use tax laws are very difficult to enforce, but some states have started putting use tax questions on their income tax forms. There is currently a great debate about the fairness of the current laws.

In the U.S. an organization can do anything it wants with the personal information it collects from individuals, unless it has a stated policy limiting its actions. There are efforts to get on-line organizations to state and adhere to a privacy policy and to enact laws limiting what organizations can do with this data.

How can I protect my children and grandchildren from objectionable material on the

Web when the courts keep throwing out the laws passed to protect children? What are the limits on material I can download and store on my computer? How can gambling websites operate when it is illegal in the US to transmit gambling information over telephone lines?

The problem with the child protection laws is that there is no practical way to allow adults their First Amendment rights to free speech. You can install and use filtering software, but there are severe limits on the capabilities. You can monitor the child's on-line activities.

Except for explicit exceptions to the First Amendment (child pornography, libelous statements, proprietary information, etc.) you can download and store anything you find on the Internet. Other countries do not have such legal systems and may restrict the accessing and ownership of certain forms of materials. This is an important issue for the Internet because it basically doesn't recognize national borders.

I don't know how gambling sites can operate legally using telephone lines.

Can my neighbors really access my computer files and print on my printer if I use one of the new high-speed Internet connections? How do these new services differ from my plain old dial up access?

Unless you have disabled all file and resource sharing, the people who share your cable data channel can easily access your computer. If you also want to operate a home computer network, you have a problem.

Both cable Internet access and DSL do not use the switched telephone network. In addition, cable companies are not common carriers so they may exercise more control over what you access with your computer than the telephone companies. There are numerous unsolved technical, security, privacy and policy issues using these services.

When will I be able to buy an affordable High Definition TV (HDTV)? When will I *have* to buy a HDTV set? Will I still be able to record HDTV programs for my own personal use?

Affordable HDTV systems will be available when there is a mass market for them (like UHF enabled TV sets many years ago). There are many unresolved technical and policy issues.

At some point a few years from now (when the broadcasters return their analog channels) you will have to buy a HDTV set or a converter for your present set. This will not happen until these become affordable.

Because of the concerns of the producers of digital TV programming, we are currently headed towards a situation of copy protected technology which will not let you make recordings. Many issues are unresolved such as how to provide fair use. And remember the Betamax decision.

Why is the government picking on Microsoft? Why does the government need to fund computing research with all the rich computer companies out there? What's this Digital Divide I keep hearing about and why is it important to me?

Many people feel that Microsoft illegally used its likely monopoly status in operating systems to restrict competition in other software.

Most companies, even pharmaceutical companies, rely heavily on the results of government funded basic research. Most companies are not equipped to make good decisions on basic research. Many argue that the success of government funded basic research in the last fifty years has been responsible for much of the economic growth in the United States.

The digital divide refers to the fact that computer and Internet access is not uniformly distributed across all ethnic, social and economic classes and this is a potentially limiting situation in equitable access to our legal, government and economic systems. Also, disabled people may not have good access to computers and the Internet. A recent court ruling has said that accessibility laws apply to both computers and the Internet. Computer-based voting systems may become the next big access issue.

If I don't like how things are going, what can I do about it?

As with other policy issues, effective computing policy activity requires informed citizens who then approach their government representatives either individually or in organized groups to effect changes. Fortunately for those who have access, the Internet is an excellent resource for information. Use search engines and be sure to find out who really sponsors a site (e.g., HRRC). Be sure to look at web sites ending in ".org".

Disclaimer

The author is not an attorney and the material in this work should not be considered legal advice. The material is the personal opinion of the author. The references to certain URLs contained in this work are provided as a service to the reader. Their presence should not be interpreted to mean that the author either supports or endorses the referenced material

The author has made a best effort to determine the validity of the material at the time of writing, but makes no claims as to its continued validity.

About the Presenter

Bob Ellis and his wife have lived in XXX since 1995. Bob retired in 1993 as Sun Microsystems' representative on the Technology Committee of the Computer Systems Policy Project (CSPP - an industry policy study organization) and co-manager of Sun's university research program. Previously, he held computer graphics software development and management positions with Sun, GE-Calma, Atari, Boeing and Washington University (St. Louis, MO). He received BS and MS degrees in Electrical Engineering and Computer Science from Washington University (St. Louis). Bob currently does work as a volunteer for technical societies; he is a member of the Association for Computing Machinery's (ACM) US Public Policy Committee (USACM) serves as the Chair of the Public Policy Program of ACM's Special Interest Group on Computer Graphics and Interactive Techniques (SIGGRAPH).

References

General

The Association for Computing Machinery (ACM) U.S. Public Policy Committee (USACM) - http://www.acm.org/usacm/
ACM SIGGRAPH Public Policy Program - http://www.siggraph.org/pub-policy/

Privacy

Electronic Frontier Foundation (EFF) - http://www.eff.org/
Electronic Privacy Information Center (EPIC) - http://www.epic.org/
USACM on Encryption - http://www.acm.org/usacm/crypto/
USACM on Privacy - http://www.acm.org/usacm/privacy/

Intellectual Property (Including Digital Copy Control)

American Library Association (ALA) Policy Activities - http://www.ala.org/work/
Home Recording Rights Coalition (HRRC) - http://www.hrrc.org/
Motion Picture Association of America (MPAA)/Motion Picture Association (MPA) - http://www.mpaa.org/
Recording Industry Association of America (RIAA) - http://www.riaa.org/
USACM on Copyright - http://www.acm.org/usacm/IP/#copyright
USACM Intellectual Property Library - http://www.acm.org/usacm/IP/

Electronic Commerce

UCITA

Americans for Fair Electronic Commerce Transactions - http://www.4cite.org/
Association of Research Libraries - http://www.arl.org/info/frn/copy/ucitasum.html
Bad Software - http://www.badsoftware.com/
Computer Professionals for Social Responsibility - http://www.cpsr.org/program/UCITA/ucita-fact.html
Digital Commerce Coalition - http://www.ucitayes.org/
Institute of Electrical and Electronics Engineers (IEEE) on UCITA - http://www.ieeeusa.org/forum/grassroots/ucita/index.html
Federal Trade Commission - http://www.ftc.gov/be/v990010.htm
National Conference of Commissioners on Uniform State Laws - http://www.nccusl.org/
UCITA News - http://www.ucitanews.com/
UCITA On-Line - http://www.ucitaonline.com/
USACM on UCITA - http://www.acm.org/usacm/IP/#ucita

Free Speech

American Civil Liberties Union - http://www.aclu.org/issues/cyber/burning.html
Center for Democracy and Technology - http://www.cdt.org/
Electronic Frontier Foundation (EFF) - http://www.eff.org/
Internet Free Expression Alliance - http://www.ifea.net/
Responsibility in Free Speech - http://www.zondervan.com/green.htm
USACM on Free Speech - http://www.acm.org/usacm/speech/

Broadband Internet Access

BroadBand Internet - http://www.broadband-internet.org/
Broadband Wireless Internet Forum - http://www.bwif.org/
CableLabs - http://www.cablelabs.com/
DSL Forum - http://www.adsl.com/
Federal Communications Commission - http://www.fcc.gov/broadband/
NetAction - http://www.netaction.org/

Digital Television

Association of Local Television Stations - http://www.altv.com/
DigitalTelevision.com - http://www.digitaltelevision.com/
Federal Communications Commission - http://www.fcc.gov/dtv/
National Association of Broadcasters - http://www.nab.org/
PBS - http://www.pbs.org/digitaltv/

Computing Research Support

Computing Research Association (CRA) - http://www.cra.org/
USACM on Science Research Support - http://www.acm.org/usacm/funding/

Equitable Access and the Digital Divide

Closing the Digital Divide - http://www.digitaldivide.gov/
PBS - http://www.pbs.org/digitaldivide/